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# **Manual of Naval Preventive Medicine**

## **Chapter 5**

### **WATER SUPPLY ASHORE**

#### **DISTRIBUTION STATEMENT "A"**

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# **NAVMED P-5010-5**

## **Chapter 5 Manual of Naval Preventive Medicine Water Supply Ashore**

**23 Jun 2008**

To: Holders of the Manual of Naval Preventive Medicine

1. **Purpose.** This revision provides general public health and preventive medicine guidance for Department of the Navy personnel concerned with the medical surveillance of public water systems at shore facilities.
2. **Background.** All CONUS Navy and Marine Corps public water systems shall comply with Federal and State law. For OCONUS locations, Navy and Marine Corps public drinking water systems must comply with Final Governing Standards or DoD Overseas Environmental Baseline Guidance Document as applicable.
3. **Action.** Replace entire chapter 5 with this version.



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Chief, Bureau of  
Medicine and Surgery

# CHAPTER 5

## WATER SUPPLY ASHORE

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**5-1. Purpose.** This chapter provides general public health and preventive medicine guidance for Department of the Navy personnel concerned with medical surveillance of public water systems at shore facilities. All public water systems must be operated and maintained to comply with all Federal and State laws/rules as well as Department of Defense (DoD), Department of Navy (DON) directives.

### 5-2. Background

a. The Safe Drinking Water Act (SDWA) was signed into law on 16 December 1974. The SDWA and subsequent amendments directed the U.S. Environmental Protection Agency (EPA) to develop federally enforceable National Primary Drinking Water Regulations (NPDWR) for a public water system (PWS). As a result of this legislation, primary enforcement authority (primacy) has been delegated to the individual States.

b. Under the SDWA, EPA has developed National Secondary Drinking Water Regulations (NSDWR) for all public water systems. NSDWR refer to contaminants which may affect the aesthetic quality of drinking water. Unlike the NPDWR, the NSDWR are not federally enforceable; but may be incorporated into State law and enforced by respective States.

### 5-3. Policy

a. Department of Defense Directive (DoDD) 6230.1 sets forth policy that all public water systems in the United States shall comply with the SDWA along with applicable EPA rules. Regulations for drinking water purchased or produced at Navy and Marine Corps outside the Continental United States (OCONUS) installations are included in environmental documents published by DoD. These DoD regulations do not apply to operational and training deployments off-base, U.S. Naval vessels, and U.S. military aircraft.

(1) Environmental *Final Governing Standards*, for drinking water quality standards have been established for specific OCONUS DoD installations.

(2) When Environmental *Final Governing Standards* have not been established for OCONUS DoD installations, refer to the *Overseas Environmental Baseline Guidance Document* for the drinking water quality standards.

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- b. OPNAVINST 5090.1 series and Marine Corps Order (MCO) P5090.2 series, *Environmental and Natural Resources Program Manuals*, set forth the policies and procedures for implementing the SDWA and the Federal drinking water regulations found in 40 Code of Federal Regulation (CFR) parts 141-143. The NPDWR are published in Title 40 CFR 141 and NSDWR are published in 40 CFR 143.
- c. BUMEDINST 6240.10 series, *Standards for Potable Water*, provides general public health guidance regarding medical surveillance for potable water systems for naval vessels and operational field water sources. NAVMED P-5010-6 provides medical surveillance guidance for shipboard potable water systems.
- (1) DoD Tri-service Field (Deployment) Drinking Water Quality Standards have been established and a revision is forthcoming. Appendix F provides guidance for chlorine residual requirements for field water, Reverse Osmosis Water Purification Unit (ROWPU) sources and supercedes the information in NAVMED P-5010-9 dated June 1991. A tri-service field water medical surveillance publication is near completion with a preliminary objective of publishing the document as a stand alone chapter to the Naval Manual of Preventive Medicine upon approval. This publication will be a tri-service field water medical surveillance guide using current U.S. Army TB MED 577, *Sanitary Control and Surveillance of Field Water Supplies* as a starting point. USACHPPM Technical Guide 230, *Chemical Exposure Guidelines for Deployed Military Personnel*, is a valuable reference source that provides military exposure guidelines (MEGs) for specific chemical contaminants for a field drinking water source. These MEGs provide guidance for assisting the Preventive Medicine Authority (PMA) in advising line commanders regarding field drinking water quality contaminant concerns. This document was developed using the DoD established operational risk management (ORM) concept.
- (2) Commercial off the shelf (COTS) handheld microbiological purifiers intended to be procured by military units to be used in emergency situations must be tested and certified by the manufacturer to National Sanitation Foundation International (NSF) Protocol P248, *Emergency Military Operations: Microbiological Water Purifiers*. DON units purchasing such COTS units should ensure they have been tested and certified to this protocol. This procedure provides for an independent third party validation of manufacturer's claim regarding the treatment efficacy of their product(s).
- (3) Direct chemical additives to a potable water system should be tested and certified by the applicable manufacturer(s) in accordance with NSF/American National Standard Institute (ANSI) Standard 60: *Drinking Water Treatment Chemicals – Health Effects*. Likewise, indirect chemical additives to a potable water system should be tested and certified by the applicable manufacturer(s) in accordance with NSF/ ANSI Standard 61: *Drinking Water Components – Health Effects*. This is the water purveyor's (public works) responsibility.
- (4) The water purveyor should ensure all Point of Use (POU) and Point of Entry (POE) drinking water treatment devices have been tested and certified to the applicable NSF/ANSI standard by the manufacturer using an independent third party accredited laboratory. The use of POU and POE devices shall comply with EPA, State, and DoD drinking water regulatory requirements as applicable.

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### **5-4. Responsibilities**

#### **a. Chief, Bureau of Medicine and Surgery:**

(1) Establishes and publishes appropriate medical surveillance guidance for shipboard and operational field water sources as set forth by BUMEDINST 6240.10 series.

(2) Provides public health consultative assistance to DON Commands in carrying out their medical surveillance responsibilities for public water systems. Appendix C provides information for preventive medicine assistance.

#### **b. Preventive Medicine Authority (PMA):**

(1) The PMA has an advisory role and provides public health related consultant assistance as needed.

(2) The PMA provides preventive medicine oversight of medical surveillance aspects of the potable water system such as liaison with public works (water purveyor), certified water laboratory, and local, State, and Federal regulatory authorities as applicable. Appendix A is a medical surveillance program sample template which provides general guidance. This template does not fit all locations. The local PMA should develop a local medical surveillance program for their area of responsibility based on local considerations.

#### **c. Navy Facilities Engineering Command (NAVFAC):**

(1) The water supplier or purveyor shall ensure that only approved direct and indirect chemical additives which have been tested and certified to NSF/ANSI Standards 60 and 61, respectively, are used in public water systems. NAVFAC may assist installations in the development of contracts and selection of certified laboratory services for potable water compliance monitoring.

(2) Provides engineering, contracting, and legal assistance, upon request, to major claimants and installations.

(3) Maintains drinking water information systems.

#### **d. Regional Environmental Coordinators:**

(1) Provide coordination and assistance to installations within the applicable region regarding implementation of OPNAVINST 5090.1 series, Chapter 8 and MCO P5090.2 series, Chapter 3.

(2) Assist claimants with resolution of issues and communication with CNO (N45) as well as Federal, State, and local regulators.

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### **e. Major Claimants:**

(1) Implement the drinking (potable) water program requirements at their shore installations.

(2) Plan, program, budget, and provide funding for current and future requirements under the SDWA, State and local regulations, and Navy and Marine Corps policy.

### **f. Commanding Officers or Officers in Charge of Shore Installations:**

(1) Ensure the installation is in compliance with all Federal, State, and local regulations, Executive Orders, and Navy and Marine Corps policy pertaining to drinking water. This includes planning, programming, and budgeting resources to meet requirements. The Installation Commander is responsible for ensuring CCRs and Public Notifications are released and distributed when applicable.

(2) Ensure contracts between the Navy and Marine Corps and water suppliers require the water purveyor to supply the test results of all permit required NPDWR monitoring that was performed on raw and treated water that serves the applicable installation and/or activity at least once a year.

(3) Ensure all personnel involved in the drinking water program are properly trained.

(4) Provide for proper sampling and analysis for SDWA, State, and DON compliance monitoring via EPA, State, or DON-certified laboratories.

(5) Identify and submit compliance projects per OPNAVINST 5090.1 series, Chapter 1 or MCO P5090.2 series, Chapter 3.

(6) Ensure an adequate number of facilities are included in the primary supplier's lead and copper sampling pool, and that appropriate action is taken, either by the primary supplier or the facility.

(7) Perform lead and copper monitoring, when the water supplies are not included in the primary supplier's sampling pool.

(8) Ensure a cross-connection and backflow prevention program is established and implemented at each installation.

(9) Conduct vulnerability assessments and sanitary surveys.

(10) Ensure plumbing repairs made to installation drinking water systems use only lead-free materials.

(11) Develop and implement appropriate mitigation programs based on monitoring results, as needed.

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(12) Report noncompliance with any NPDWR (including failure to comply with monitoring requirements, variances, or exemptions) in accordance with OPNAVINST 5090.1 series and MCO P5090.2 series.

(13) Develop and distribute CCRs.

(14) Protect underground sources of drinking water from contamination. Establish and implement an underground injection control program and wellhead protection program, if necessary.

(15) Ensure an operation and maintenance program is established and implemented at each installation. This applies to both primary and consecutive water supplies.

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## **Section II. IMPORTANCE OF POTABLE WATER**

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### **5-5. General**

- a. Most community water suppliers deliver high quality drinking water to millions of Americans every day. Of the more than 55,000 community water systems in the United States, only 4,769 (8.6 percent) reported a violation of one or more drinking water health standards in 1996.
- b. Nationwide, drinking water systems have spent billions of dollars to build and maintain drinking water treatment and distribution systems.
- c. Furthermore, there is a network of government agencies empowered to ensure that public water supplies are safe. Nonetheless, problems with local drinking water occur.

### **5-6. Impurities and Contaminants in Drinking Water**

- a. All sources of drinking water may contain some naturally occurring impurities or contaminants. Because water is the universal solvent, many materials are easily dissolved upon contact. Removing all impurities or contaminants would be extremely expensive and in nearly all cases would not provide additional health benefits. A few of the naturally occurring substances may actually improve the taste of drinking water and may have nutritional values at low levels.
- b. As population growth and development of natural areas increase, there are growing numbers of contamination threats to drinking water. Suburban sprawl has encroached upon watersheds, bringing with it potentially hazardous by-products. Instances of serious drinking water contamination occur infrequently, and typically not at levels posing acute health concern. Nonetheless, with the threats of such events increasing, drinking water safety cannot be taken for granted and ongoing surveillance of a PWS is a force protection critical consideration.

### **5-7. Microbiological Considerations**

- a. Microbiological contaminants can enter water supplies as a result of human and animal activity. Animal waste from feedlots, pastures, lawns, etc., may be discharged to receiving waters that ultimately flow to water bodies used as a drinking water source. Human waste can contaminate water supplies through non-point sources such as septic tank systems and/or point sources such as a sewer plant discharges. Floods and storm water runoff are also non-point

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sources of microbial contamination. Coliform bacteria from human and animal wastes may be found in drinking water if the water is not properly treated and disinfected. Total coliform bacteria are used as the indicator organisms for microbiological water quality. Their presence indicates that harmful organisms may also be in the water and/or the disinfection treatment system is not working properly.

b. The potential for health problems from drinking water is illustrated by localized outbreaks of waterborne disease. Many of these outbreaks have been linked to contamination by bacteria or viruses, probably from human or animal waste.

c. Certain pathogens, such as *Cryptosporidium*, may pass through water treatment filtration and disinfection processes in sufficient numbers to cause health problems. These pathogens may also enter groundwater through a direct hydraulic connection to a nearby surface water supply or runoff. *Cryptosporidium* is a protozoan that causes the gastrointestinal disease cryptosporidiosis. The most serious and sometimes deadly, consequences of cryptosporidiosis tend to be focused among sensitive members of the population such as individuals with immune system deficiencies.

d. Microbial contamination of the water in the distribution system can occur due to: loss of halogen (chlorine) residual, the air-water interface in storage tanks, water piping breaks and repairs, construction, and cross connections. The loss of halogen residual within a distribution system may be the result of numerous factors including long detention time in storage tanks, oversized transmission lines, dead-ends, and closed valves that can create artificial dead-ends. In addition, the accumulation of organic and inorganic matter such as sediments, debris, corrosion by-products, and biofilm can contribute to the loss of the halogen residual. Loose or missing screens on storage tanks or reservoir vents can provide the opportunity for birds and other animals to enter the storage tanks or reservoirs and contaminate the water. Pipeline breaks, repairs, and construction provide opportunities for microbial contamination of the potable water distribution system.

e. Bacteria and other microorganisms in a potable water distribution system may be associated with biofilm that attach to surfaces within the distribution system. Biofilms are an accumulation of microorganisms, extra cellular material, and debris that is attached to the interior walls of some distribution system pipes, tanks, and reservoirs. Biofilm organisms are usually not a direct health risk. However, biofilm can be responsible for microbiological water quality standard violations such as growth of total coliform bacteria. Biofilm growth has also been associated with increased concerns as biofilm can harbor pathogens such as *Legionella*. Appendix H provides additional information of *Legionella*. Repeated positive total coliform tests may be an indicator a biofilm problem exists. *Klebsiella* bacteria which are members of the total coliform group are ubiquitous in the environment and originate from a wide variety of both animal and plant sources. Their presence is often responsible for total coliform positive tests, but does not necessarily imply an acute health risk exists. However, presence of total coliform is a violation of the EPA Drinking Water Standard and indicates the water purveyor needs to take remedial actions such as increased distribution system flushing and/or boosting the halogen residual level. For clarification of coliform violations refer to the EPA Total Coliform Rule (TCR) and Public Notification requirements for Tier 1 and Tier 2 TCR violations.

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f. There are a number of factors that may increase biofilm growth in a distribution system. Examples are temperature, hydraulic effects (flow velocities), nutrient availability (e.g., carbon, phosphorus, and nitrogen), loss of halogen residual, corrosion, and sediments. An early warning indicator of biofilm growth in the distribution system is a high HPC laboratory test. Water utilities often conduct these tests to monitor biofilm growth in the distribution systems and triggers flushing response.

### 5-8. Physical and Chemical Considerations

a. **Physical Considerations.** Physical characteristics of water such as clarity, taste, odor, temperature, and turbidity will impact palatability. Only turbidity is regulated by the NPDWR.

(1) Water turbidity is cloudiness caused by suspended material consisting of clay, silt, finely divided organic material, and plankton. Turbidity is measured in nephelometric turbidity unit (NTU). When greater than five NTUs is measured, turbidity is visible in a glass of water and objectionable for aesthetic reasons. Turbidity is regulated because it can harbor bacteria and exert a high demand on chlorine. Levels between 0.05-0.3 NTU are obtained in finished water under optimal water treatment plant operating conditions.

(2) Color quality problems in water may be attributed to dissolved organic matter (amber), iron (red), or manganese (black).

(3) Ideal water temperature range for palatability is between 50-60 °F (10-15 °C). Water that is too hot will be unpalatable and personnel may refuse to drink it unless it is cooled. In field settings temperature of ROWPU water and bottled water may adversely impact drinking water source acceptance and contribute to growth of microorganisms..

(4) Odor in drinking water may be caused by a number of factors such as algal growth or hydrogen sulfide (rotten egg smell).

(5) Drinking water taste may be impaired by dissolved minerals, which are characteristic of the local geology. It is rarely measured since treatment plants cannot alter water mineral characteristics. Signs or symptoms of water quality problems such as hard water, salty or brackish taste, musty or earthy smell are not likely to cause adverse health problems but will negatively impact the taste and smell of water thus impacting palatability.

b. **Chemical Considerations.** The chemical makeup of drinking water supplies is a result of natural (e.g., local geology) and man-made activities. Title 40 CFR 140-143 sets forth the National Drinking Water Quality Standards establishing maximum contaminant levels (MCL). Bottle water quality standards are found in Title 21 CFR 165.

(1) Primary Drinking Water Standards establish legally enforceable MCLs for numerous contaminants that may be found in drinking water. Adverse health effects have been observed when various chemical contaminants exceed established safe levels. Examples of adverse health effects from exceeding the established water quality MCLs include:

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(a) Nitrate, an inorganic contaminant, if present in drinking water above 10 ppm may pose an immediate threat to infants less than 6 months of age. This serious condition, commonly referred to as “blue baby syndrome,” may be life threatening without prompt medical attention.

(b) Other inorganic contaminants (e.g., copper, lead, arsenic, cadmium, mercury, and recently added thallium) if present in drinking water at levels above their respective MCLs can cause serious health problems ranging from skin lesions, hair and fingernail loss, to kidney and intestinal or liver problems.

(c) Exposure above the MCL to organic contaminants (discharges from industrial factories, runoff from herbicide and pesticide use) can cause a myriad of ailments ranging from liver and kidney problems to reproductive difficulties and increased risk of cancer.

(2) Secondary Drinking Water Standards refer to nonenforceable guidelines for contaminants that may cause cosmetic (e.g., tooth discoloration) or aesthetic (e.g., taste and odor) effects from drinking water. Examples of secondary contaminants deemed to cause benign health effects in subgroups within the general population include:

(a) **Sulfate.** Health concerns regarding sulfate in drinking water have been raised because of reports that diarrhea may be associated with the ingestion of water containing high levels of sulfate ( $> 500\text{mg/l}$ ).

(b) **Sodium.** The EPA Office of Water has issued a Drinking Water Advisory to provide guidance to communities that may be exposed to drinking water containing sodium chloride or other sodium salts. The Advisory does not recommend a reference dose because data for quantifying risk are limited. Rather, the Advisory provides guidance on concentrations at which problems with taste would likely occur. It is recommended sodium concentrations be reduced to levels between 30 to 60 mg/L for esthetic effects (i.e., taste). An EPA guidance level of 20 mg/L for sodium in drinking water was developed for those individuals restricted to a total sodium intake of 500 mg/day and should not be extrapolated to the general population.

**5-9. Radiological Considerations.** Most drinking water sources have very low levels of radioactive contaminants (radionuclides). Very low naturally occurring levels are not considered to be a public health risk. Of the small percentage of drinking water systems with radioactive contaminant levels high enough to be of concern, most of the radioactivity is naturally occurring in certain rock types. Radionuclides found naturally in rock emit “ionizing radiation” as they radioactively decay. Aquifers in such rock will absorb the radiation. Long-term exposure to radionuclides in drinking water may cause cancer. Aerosolizing and inhalation is a potential pathway for human exposure when too much radiation contamination (radon) is in water. Additionally, ingestion of Uranium decay products through drinking water can cause toxic effects to the kidney.

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### Section III. WATER SOURCES

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#### 5-10. General

**a. Drinking water comes from surface and ground water.** Large-scale water supply systems tend to rely on surface water resources, while smaller water systems tend to use ground water. Slightly more than half of the population receives their drinking water from ground water sources, including the millions of Americans who use ground water as private drinking water wells.

**b. Surface water includes rivers, seas, oceans, lakes, and reservoirs.** Ground water is pumped from wells that are drilled into aquifers. Aquifers are geologic formations that contain water. The quantity and quality of water in an aquifer depend on the nature of the rock, sand, or soil in the aquifer from which the well withdraws water. Drinking water wells may be shallow (50 feet or less) or deep (more than 1,000 feet). The water utility or Public Works department can identify the source of the public drinking water supply. Well construction and wellhead protection is critical for protecting a ground water source from contamination.

#### 5-11. Public Water Supply (PWS)

a. The SDWA defines a PWS as one that serves piped water to at least 25 persons or 15 service connections for at least 60 days per year. Such systems may be owned by homeowner associations, investor-owned water companies, local governments, or others. Water that does not come from a public water supply, and does not meet the definition of a public water supply is considered a private water supply and is not covered by SDWA rules. State or local health departments often have rules governing private water supplies.

b. Community water systems are a PWS that serves the same people year-round. Non-community water systems are a PWS that does not serve the same people year-round. There are two non-community PWS types. Non-transient, non-community water systems (NTNCWS) serve the same people more than 6 months per year, but not year-round. An example would be a water system for a school. Transient non-community water systems serve the public, but not the same individuals for more than 6 months. Examples would be a campground or a restaurant. The SDWA applies to these different systems with different rigor, since consumer exposure to potential contaminants varies among the type of system. The transient non-community systems only have to comply with regulations that govern contaminants (such as microbiological and nitrate/nitrite) that may result in acute health effects, rather than health effects associated with

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long-term exposure to contaminants (such as organic carcinogens). The NTNCWS must comply with all regulations that apply to community water systems. As a general rule, if the Navy or Marine Corps owns and operates a water system and has a housing area, the system is a community water system. However, some remote range and testing facilities, as well as some MWR camping facilities may be served by an NTNCWS.

- c. Many installations have isolated water sources, such as wells and springs, for drinking water in training areas. In many cases, these isolated water sources do not serve 25 individuals daily for 60 days a year and have less than 15 service connections; therefore, they are not classified as public water systems. However, these sources must be protected from contamination and medical surveillance of the water quality is essential. Monthly microbiological testing as part of a medical surveillance program is needed when the water source is being consumed. Annual testing for nitrate (MCL 10 ppm) should also be completed. Springs are more susceptible to contamination than wells and are not recommended to be used as a water source.
- d. OPNAVINST 5090.1 series and MCO 5090.2 series describes consecutive water systems and other non-public water systems.

### 5-12. Wells and Springs (Groundwater)

#### a. Wells

(1) **Groundwater occurs in geologic formations called aquifers.** Aquifers contain saturated permeable material that yields water to wells and springs. An aquifer serves as a transmission conduit and storage reservoir that transports water under a hydraulic or pressure gradient from recharge areas to water-collecting areas. Groundwater, when available, is usually an excellent water supply source. Such water can be expected to be clear, cool, colorless, and quite uniform in character. It is generally of better microbiological quality and contains much less organic material than surface water, but may be more highly mineralized. At present, wells serve small to medium-size installations, although a system of multiple wells may be used to develop a supply for large installation.

(2) **Types of Wells.** Wells are classified according to the construction method, i.e., dug, bored, driven, drilled, or jetted. Each type of well has distinguishing physical characteristics that are best used to satisfy a particular need. UFC 3-230-02 gives descriptions of particular well types and design considerations. Dug, driven, and bored type wells are more susceptible to contamination and generally have a poorer water quality. Properly constructed drilled or jetted wells are preferred sources.

(3) **Sanitary (Wellhead) Protection.** Proper sanitary measures must be taken to ensure the safety of water whenever ground water is pumped from a well for human consumption. Potential sources of contamination may exist above or below ground level. Where possible, wells will be located on ground that is higher than a potential source of contamination. The area must be drained well to divert surface waters from the well and reduce the possibility of flooding. Listed below are guidelines for the sanitary protection of wells:

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- (a) The annular space outside the casing must be filled with water-tight cement grout per EPA Manual of Individual Water Supply Systems or State regulations.
- (b) For artesian aquifers, the casing must be sealed into the overlying impermeable formations to retain the artesian pressure.
- (c) When a water-bearing formation containing water of poor quality is penetrated, the formation must be sealed off to prevent the infiltration of water into the well and developed aquifer.
- (d) Every well must be provided with an overlapping watertight cover at the top of the casing, or a raised pipe sleeve to prevent contaminated water or harmful materials from entering the well.
- (e) All abandoned wells must be plugged and properly sealed, as required by State, Federal, or local authority, to prevent contamination of the ground water formation and for safety reasons. The basic concept behind the proper sealing of any abandoned well is that of restoration of the controlling geological conditions that existed before the well was drilled or constructed. If restoration can be done, an abandoned well will not create a physical or health hazard. American Waterworks Association (AWWA) Standard A100-66 provides further guidance on this subject. Table 5-12-1 is the suggested minimum distance a well must be located from sources of contamination. In some areas, various soils and rock formations may require increased distance. Primacy Agency and local health departments may also have regulations for various setback distances. A sanitary survey, conducted by qualified individuals, must be a matter of policy in the construction or drilling of any new well with nearby potential contamination sources. Primacy Agency and local health departments must be contacted in each area.

**Table 5-12-1**  
**Minimum distance between wells or springs and**  
**various potential sources of contamination**

Potential Contamination Source	Well or spring (Distance in feet)
Sewer Line (watertight)	50
Septic Tank (watertight)	50
Disposal Field	100
Seepage Pit	150
Cesspool	150

- (f) Generally, groundwater is considered to be free from pathogenic organisms. This is based on the assumption that soil acts as an effective treatment media removing harmful microorganisms. The “filtered” microorganisms subsequently find themselves unable to multiply and eventually die. However, there are cases where surface water can influence groundwater supplies, thus causing the groundwater to become vulnerable to microbial contamination. The groundwater is then considered to be under the direct influence of surface water. Groundwater sources to be considered for potable water supply must meet established Federal EPA procedures pertaining to groundwater under the direct influence of surface water if

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applicable. Each well source serving a public water system must be evaluated to determine whether or not the well is directly influenced by surface water in which case the groundwater would be classified as groundwater under the direct influence of surface water (GWUDISW) and is defined in the EPA Primary Drinking Water Standards located in 40 CFR 141.2.

### **(g) Disinfection**

1. Drilled, jetted, bored, and driven wells must be disinfected after construction, cleaning, or removal of equipment for repair. After disinfection the well must be flushed by pumping to waste until the water is clear. Calculate the quantity of water in the well based on the depth of water and the diameter of the casing. Introduce enough chlorine solution to obtain 100 parts per million (ppm) through a clean hose that is raised and lowered to all depths of the well water. A spray nozzle must be used to disinfect the inside of the casing and the outside of the riser. Operate the pump until a distinct odor of chlorine can be detected, then check the free available chlorine (FAC). When 100 ppm FAC is obtained, allow the well to stand for 24 hours and then pump to waste until the chlorine drops to approximately 1 ppm FAC. At this point obtain at least two samples not less than 30 minutes apart for bacteriological analysis to determine no coliform bacteria are present before putting the well in service. Water quality should also be tested for organic and inorganic chemical contaminants.

2. Dug Wells. This type well should be used as a last resort and only in emergency situations because of high susceptibility to contamination. After the casing/lining is completed and prior to placing the cover over the well, disinfection is accomplished by the following steps: Remove everything, (e.g., tools, equipment, and structures) which will not be part of the well. Determine the quantity of water in the well and the amount of disinfecting solution needed. Scrub the casing or lining wall with a stiff broom or brush and a 100 ppm chlorine solution. Place the well cover in position and introduce the disinfecting solution through a clean hose that is raised and lowered to all depths of the well water. Wash the outside of the pump cylinder and piping as the unit is lowered into the well. After the pump is in place, pump the water until a distinct odor of chlorine is detected at which point the chlorine residual is checked. When 100 ppm FAC is measured, allow the well to stand for 24 hours before pumping the well until the chlorine residual is reduced to 1 ppm. When 1 ppm is obtained take samples for bacteriological analysis. Chemical testing of water for volatile organic compounds (VOCs), synthetic organic contaminants (SOCs), inorganic chemicals (IOCs), etc., is needed.

### **b. Springs**

(1) Springs are formed at the intersection of an aquifer with the ground surface, or by leakage of an artesian aquifer through a fracture or solution zone. Contrary to popular belief, spring water is not always of good microbiological quality. Contamination concerns associated with a spring water source for potable water are usually higher than with a groundwater source. Extreme caution must be exercised in the development of springs for potable water use. Generally, the same principles that apply to location, protection, development, and operation of wells apply to springs. The factors presented above for well location must also be considered when conducting a sanitary survey of a spring.

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(2) Protection. When used as a water source, spring water is usually captured in a small catchment reservoir to enclose and intercept as much of the spring as possible.

(3) A spring water collection system is similar to a groundwater well and when serving a public water system must be evaluated to determine whether the spring is influenced by surface water. The vulnerability assessment and ensuing mandatory treatment and disinfection requirements of springs determined to be under the influence of surface water are comparable to those described in article 5-12a(3)(f). There are however additional assessment criteria that apply to spring water sources:

- (a) Presence of an impervious barrier over the collection pipes to keep rainwater runoff from contaminating the spring.
- (b) Presence of a diversion ditch around the upper end of the spring area.

(4) Spring Disinfection. Spring encasements must be disinfected by scrubbing the inside of the encasement above the water line with a stiff brush or broom and 100 ppm chlorine solution. When the flow can be stopped or maintained within the encasement, determine the volume of water and add enough chlorine solution to the water to obtain a 100 ppm FAC residual in the water. Let the spring stand 24 hours and discharge to waste until the FAC residual is approximately 1 ppm. Take samples and place in service as described for wells. When the spring flow cannot be stopped, enough chlorine must be continuously fed into the contained water in the spring encasement, near the inlet, to result in 100 ppm FAC in the outlet. This residual must be maintained for at least 24 hours.

c. **Modification of Sources.** Sources deemed under the influence of surface water may be altered in some cases to eliminate the surface water influence provided the primacy agency approves the modifications. The available modifications include:

- (1) Trenching to divert surface runoff from springs.
- (2) Redeveloping springs to capture them below a confining layer.
- (3) Covering open spring collectors.
- (4) Reconstructing wells to install sanitary seals and/or screen them in a confined Aquifer.
- (5) Repairing cracks or breaks in any type of source collector that allows the entry of surface water.
- (6) Discontinue the use of infiltration laterals which intercept surface water.
- (7) If modification is not feasible, another alternative may be to develop a new well either deeper or at a different location. An extended period of monitoring should follow reconstruction (at least 2 years) to assess whether the influence of surface water has been eliminated.

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### 5-13. Surface Water

**a. Surface water generally is obtained from rivers, streams, and lakes.** Because of the ease of physical and microbiological contamination of surface water, additional factors not usually associated with ground water sources, must be considered when selecting surface water sources. As a general rule, surface water should only be used when ground water sources are not economically justifiable or are of inadequate quality or quantity.

**b. Source Selection.** In examining surface waters for potential use as drinking water sources, care must be exercised. A number of interrelated factors need to be considered. These include, but are not limited to: sources of pollution, hydrological studies, proposed intake location, and water uses identified for the particular water source by responsible governmental agencies. Raw water quality should be examined and a treatment scheme proposed to make sure applicable regulations are followed and to give the best possible water supply for Navy and Marine Corps use before a final determination regarding the acceptability of the source is made. Acute health effects from exposure to microbial pathogens (viruses, bacteria and protozoa) are documented and associated illness can range from mild to moderate cases lasting only a few days to more severe infections that can last several weeks and may result in death for those with weakened immune systems.

**c. Treatment.** The SWTR as amended seeks to ensure that treatment of surface water is performed to provide improved protection of drinking water from microbial contaminants present in surface water including viruses, *Legionella*, *Giardia lamblia* and *Cryptosporidium*. A detailed overview of these regulations are provided in article 5-41 under the heading Surface Water Treatment Rule.

**d. Recreational Use of Surface Sources.** Surface waters that are used as a potable water source may have desirable recreational qualities, e.g., fishing, boating, picnicking, and bathing. A surface water source must not be used for drinking water purposes if the water treatment plant does not include filtration and if sedimentation, resulting from storage in reservoirs followed by chlorination, is the only treatment provided. Care must be exercised in determining what types of recreational activities (swimming, boating, etc.) are suitable for these waters. Periodic sanitary surveys must be used to evaluate the impact of recreational uses on these water sources.

### 5-14. Bottled Water

a. Bottled water is classified as a food product in accordance with Federal law and DoD regulations. Title 21 CFR 129 and 165 provide the FDA rules for bottle water. NAVSUPINST 4355.4/MCO P1011031 series, *Veterinary/Medical Food Inspection and Laboratory Service* sets forth the DoD approval process for bottle water sources. Only DoD approved bottle water sources shall be used.

b. Bottled water shall only be acquired from U.S. Army VETCOM approved sources. A list of approved sources can be found in the *Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement*.

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- c. Bottled water shall not be stored in direct sunlight. It should be stored in shaded, well-ventilated areas, and in boxes that keep the packages upright. Bottled water should be managed on a “first in – first out” basis. Bottled water improperly stored in sunlight may affect the water temperature which in turn may support bacteria growth and impact taste. In a field deployment setting additional monthly microbiological testing of bottle water by the PMA is required.

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### Section IV. WATER DISTRIBUTION SYSTEMS

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#### **5-15. General**

a. Awareness of the critical role that distribution systems play in ensuring the delivery of safe water has increased over the past several years. The distribution system is likely the weakest link in a PWS vulnerability assessment. Some of this heightened awareness is attributable to the fact that more than 25 percent of yearly waterborne disease outbreaks in the United States are attributed to distribution system deficiencies rather than inadequate treatment. The distribution system is one of the final barriers of protecting water quality prior to customer delivery. The design, operation, and maintenance of distribution systems have traditionally focused on public safety requirements and hydraulic objectives (involving flow and pressure), some of which may adversely affect water quality. For any given installation, the distribution system may contain any number of elements that can accelerate water quality deterioration. These problem areas may include:

- (1) Dead-ends where the water remains stagnant for extended periods of time.
  - (2) Tanks that are hydraulically locked out of the system; (i.e., due to water pressure constraints, tanks are not routinely emptied and filled).
  - (3) Tanks that are not turning over due to minimal demands within the proximity; (i.e., lengthy water detention time due to tank size relative to water demand).
  - (4) Oversized pipes where demands existed in the past or as a result of a change in flow patterns.
  - (5) Artificial dead-ends created by closed valves that should be open.
  - (6) Areas within the system that still contain unlined cast iron pipe.
  - (7) Areas within the system where it is difficult to maintain a disinfectant residual or that are prone to positive coliforms or high bacterial organisms measured by HPC. Appendix I provides additional information.
- b. The typical problems encountered by water systems include:
- (1) Loss of disinfectant residual within the distribution system.

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- (2) For water systems using or receiving chloramine disinfected water, excess free ammonia in the water being delivered to the distribution system.
  - (3) Bacterial regrowth (biofilm).
  - (4) Growth of nitrifying bacteria in chloramine treated water.
  - (5) Excessive levels of Trihalomethane (THMs) and/or other disinfection byproducts (DBPs).
  - (6) Inadequate or ineffective corrosion control treatment.
  - (7) Discolored water.
  - (8) Taste and odor problems.
- c. For these systems, there may be a need to go beyond the minimum requirements to ensure the delivery of a safe and acceptable drinking water supply. Water systems need to focus on water quality control within the distribution systems to minimize degradation. Available tools are listed below.
- (1) An initial distribution system survey.** The purpose of an initial distribution system survey is to identify all potential problem areas within the system, including dead-ends, oversized pipes, closed valves, storage tanks that are hydraulically locked out or not turning over, etc. The results of this survey can be used to develop a comprehensive plan to correct deficiencies within the system to improve overall water quality control.
  - (2) Implementation of a cross-connection control and backflow prevention program.** To prevent degradation of water quality it is essential that a cross-connection control and backflow prevention program be implemented. The possibility of backflow due to improper piping configuration/layout within facilities is especially significant because such cross-connections may easily result in the contamination of the drinking water system. These situations may result in the drinking water system becoming a vehicle for transmission of pathogenic organisms, toxic materials, or other hazardous substances that can adversely affect public health and welfare. The only protection against such occurrences is the elimination of cross-connections or the protection of the drinking water system by proper application of approved backflow prevention devices or installation of appropriate air gap.
  - (3) Water quality monitoring.** The quality of water in a distribution system can best be evaluated through the use of regular monitoring and sampling. Problems in water furnished by suppliers, as well as distribution system deficiencies, can often be identified before compliance problems arise, with proper water quality monitoring.
  - (4) Documentation and evaluation of customer complaints.** Documentation and evaluation of customer complaints is a valuable tool that can be used to solve problems as they arise. Customer complaints or monitoring and sampling results may indicate the need for corrective action such as unidirectional system flushing.

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**(5) Unidirectional flushing.** Of all the available tools, flushing is the single most powerful tool available to a PWS to maintain water quality control. Water distribution system personnel should have an established unidirectional flushing program. Overall, a successful flushing program will not only help to maintain acceptable water quality throughout the distribution system, but also prevent the degradation of water quality that often occurs between the water treatment plant or interconnection with the primary supplier and the customer's tap. Although implementation of an effective flushing program will provide a number of significant benefits, by itself, it will not correct other deficiencies or problems in the system. Therefore, the flushing program should be incorporated into an overall operation and maintenance plan that, in addition to flushing, includes:

- (a) Routine tank maintenance and cleaning.
  - (b) Operation of storage tanks to prevent stagnation (generally, provide for the turnover of at least one-third of the water in the tanks every day).
  - (c) Ensuring that repair crews are disinfecting and flushing line repairs/replacements.
  - (d) A valve exercise program to assure that all of the valves that should be open are, in fact, open.
  - (e) Effective corrosion control treatment.
  - (f) Additional microbiological testing by Public Works including the use of HPCs using the R2A media to provide an early warning system for localized water quality degradation.
  - (g) Computer modeling of the system to provide a tool for better operational control and planning, if possible.
- d. In addition, the use of substandard facilities for water distribution will also adversely affect the quality of the water. The safety and palatability of the water must not be impaired by defects in the system. The distribution system must not leak and, when possible, its various mains and branches will not be submerged in surface or ground water. Dead-end mains must be reduced to ensure effective circulation of the water. Water mains must be laid above the elevation of sanitary sewers and at least 10 feet horizontally from such sanitary sewers when they are parallel. Where a sanitary sewer crosses over a water supply pipe, both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10 feet on each side of crossing. A section of water main pipe shall be centered at the point of crossing.

**5-16. Cross-Connections and Backflow Prevention.** Interconnections between a potable water distribution system and a non-potable water distribution system shall never exist. Each potable water distribution system must be periodically inspected by Public Works to detect and remove all potential or existing cross-connections and to ensure that proper engineering measures, e.g., air gaps and approved back-flow prevention devices, are in place and properly

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operating. Routine and regular surveillance by Public Works and medical personnel are needed for an effective cross connections program. Backflow prevention devices shall be approved and listed by the University of Southern California, Foundation for Cross Connection Control & Hydraulic Research.

### 5-17. Water Main Flushing and Disinfection

a. The benefits of a well-defined, unidirectional flushing program include water quality improvements, reduced bacterial regrowth potential, restoration of a disinfectant residual, color/turbidity control, and corrosion control. Unified Facilities Criteria (UFC) 3-230-02 titled *Operation and Maintenance: Water Supply Systems* contains guidance for flushing potable water systems.

(1) Public Works or maintenance personnel must make sure that new or repaired mains and extensions are cleaned and flushed with potable water prior to disinfecting and placing into service. The purpose of this flushing is to clear all dirt, mud, and debris from the new or repaired mains. A velocity of at least 6 feet per second is needed for adequate flushing.

(2) Disinfecting water mains

(a) Disinfection of all potable water lines (mains) shall be in accordance with AWWA Standard C651, UFC 3-230-19N, and State requirements. All newly installed pipes must be adequately flushed before putting on line to remove dirt or debris and after chlorination to reduce excess chlorine residual. After chlorination, flush until the chlorine residual of the repaired/new line is no greater than 3.0 ppm. When making a repair (not replacement, e.g., installing a utility clamp) of existing water lines that do not come in contact with either the ground or internal flooring, flushing is sufficient without chlorination. However, the interior of all pipe and fittings (particularly couplings and sleeves) used to make a repair must be thoroughly swabbed or sprayed with a 10,000 ppm (1 percent) chlorine solution. When disinfecting a section of pipe too long to be swabbed or sprayed, the slug method as detailed in AWWA Standard C651 can be used for repairs.

(b) The water line directly upstream of the repair and the closest water line downstream of the repair must be flushed for a minimum of 30 minutes or until all water is clear.

(c) Immediately after disinfecting and flushing, the water samples should be collected and sent to a State certified laboratory for coliform analysis. The first sample should be collected immediately after the repair (at a representative point downstream of the repair) and a second sample must follow 24 hours later. Unless absolutely necessary, the water should not be returned to service until the results of the first sample are known (usually 24 hours after the sample is taken). If the water service must be resumed before that time, verify in writing, that correct disinfection and flushing procedures were followed. The laboratory being used must contact sampling personnel immediately upon knowledge of a positive result. If either the first or second bacteriological sample is positive, immediately notify the Public Works Officer, PMA and any other designated individual in order to coordinate corrective action. The designated

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individuals will control all actions until two consecutive negative samples are achieved. When bacteriological sample results will not be known, within 24 hours of the repair, and/or samples cannot be delivered to a certified laboratory, ensure the flushing and disinfection procedures above have been followed. Bacteriological samples must be collected the first normal work day and immediately delivered to a certified laboratory.

### b. Recommended Disinfection Program

(1) When installing new water lines (as part of a repair, not a new installation) 1/2 inch in diameter or larger and 10 feet or greater in length, the slug method of chlorination should be used. A slug of chlorine solution (usually 300 to 500 ppm) will be flushed through the pipe to waste. When this is done it is important to flush all the super-chlorinated water out of the line. Table 5-17-1 provides chlorine dosage guidance.

Table 5-17-1 Potable Water Piping Disinfection	
<b>Chlorine required to produce 25 ppm residual in 100 feet of pipe:</b>	
Pipe Diameter (inches)	5.25% Chlorine Solution (Sodium Hypochlorite/Household Bleach)
4	0.03 gal. (3.84 oz)
6	0.057 gal. (7.3 oz)
8	0.12 gal. (15.36 oz)
10	0.19 gal. (24.32 oz)
12	0.27 gal. (34.56 oz)
<b>Chlorine required to produce 500 ppm residual in 100 feet of pipe:</b>	
4	0.61 gal. (78 oz)
6	1.37 gal. (175.36 oz)
8	2.48 gal. (317.44 oz)
10	3.81 gal. (487.68 oz)
12	5.52 gal. (706.56 oz)

For pipe sizes that are less than 4 inches in diameter, use 1 oz. of 5.25 percent household bleach to achieve a 25 ppm residual (in 100 feet or less); use 20 oz. of 5.25 percent household bleach to achieve a 500 ppm residual.

(2) When installing water lines for new installations chlorine must be added to the line to bring the residual up to 25 ppm. The chlorinated water must be held for 24 hours; at the end of 24 hours the chlorine residual must be checked, and must be at least 10 ppm. If the chlorine residual is at least 10 ppm after 24 hours, the flushing and bacteriological sampling phases begin. If the residual is less than 10 ppm, the line must be re-chlorinated. When disinfecting lines is warranted, use the Quick Chart (Table 5-17-1) for Potable Water Piping Disinfection or if uncertain, contact the Public Works Officer and/or Environmental Director or designated individual for chlorine measurement and coordination.

(3) When chlorinating, the system not affected by the repair or the new installation must be isolated from the work. This is to ensure that the part of the system still being used by customers will not become contaminated or subject to super-chlorinated water (which can cause extreme illness).

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(4) Make sure all necessary valves are closed and holding. Isolate only the affected piping portion of the distribution system to minimize system disruption and maximize chlorination efficacy.

(5) It is preferable to add the chlorine to the line to be chlorinated before the line is closed. When this is not possible, a temporary tap must be installed in the line to add the chlorine, and then plugged after the chemical has been added. Temporary taps can also be installed to flush a line and must be plugged when flushing and sampling is complete. This is done when a convenient flushing location (e.g., hydrant, faucet, etc.) is not readily available.

(6) When dirt and/or debris must be flushed from a line, before chlorination can begin, potable water must be used. Depending on the size of the line, use a garden hose or hydrant hose connected to a potable water source (not a part of the repair or installation area) to clear the line(s).

(7) When portable gas chlorinators are used to disinfect mains, tanks, or other units, the operator's instruction manual must be consulted. The desired disinfecting residuals must be checked.

### 5-18. Pressure

a. Water distribution systems must be designed to provide an acceptable operating pressure. Areas on high ground or with high pressure demand must have a separate high service system for maintaining pressure by pumping, backed by elevated storage, whenever possible. No water main in a Navy and Marine Corps distribution system should be less than 6 inches in diameter without approval of NAVFAC Headquarters.

b. Maintaining a positive pressure at all locations within the distribution system is a critical daily operational requirement for a potable water system. Failure to maintain positive pressure could result in backflow at cross-connections and the contamination of drinking water from leaking pipes, submerged air/vacuum relief or faulty check valves. PMA should be notified in the case of loss of pressure. Reduced pressure can occur if the flow velocity increases significantly because of a large water main break, pump failure, peak demand, flushing maintenance etc. Table 5-18-1 provides recommended pressure requirements for water distribution systems.

**Table 5-18-1  
Recommended pressure requirements**

Requirement	Value (psi)	Sources
Minimum pressure	35 psi	All points within distribution system
	20 psi	All ground level points
Desired Maximum	100 psi	All points within distribution system
Fire Flow Maintenance	20 psi	All points within distribution system
Ideal Range	50-75 psi	Residences
	35-60 psi	All points within distribution system

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- c. Excessively high pressures can have a detrimental effect on water heaters, washing machines and dishwashers. Pressure reducing valves should be installed in areas with pressures greater than 75-100 psi.

### 5-19. Use of Non-Potable Water

- a. Non-potable distribution systems must be designed to prevent interconnection (e.g., by use of incompatible coupling devices) with the potable water system. The marking "NON-POTABLE" must be stenciled on the non-potable distribution system. On shore stations, color-coding of pipe connections (risers) and valves will be used to distinguish potable from non-potable systems as shown in Table 5-19-1.
- b. Non-potable water distribution systems must be physically separated from all potable water distribution systems. Only authorized personnel can operate the non-potable water distribution system.
- c. Non-potable fresh or salt water is used for fire protection, flushing, and industrial uses only when the potable water supply is insufficient for all requirements. Color codes for water connections are provided in Table 5-19-1 which comes from DoD UFC 4-150-02.

Table 5-19-1 Color coding for Shore-to-Ship Utility Connections	
Shore Service	Color (Fed. Std. 595B)
Potable Water	Blue, dark
Non-Potable Water (Fire Main)	Red
Chilled Water	Striped Blue/White
Oily Waste-Water	Striped Yellow/Black
Sewer (CHT)	Gold

- d. The use of non-potable water for bathing and laundering of clothes is prohibited for Navy and Marine Corps installations and vessels. However, severe logistic water consumption factors in field deployed settings may require the temporary use of non-potable water that has been disinfected (chlorinated) for bathing (showering) and laundering of clothes. The PMA should approve this emergency use when operational requirements exist provided increased medical surveillance is implemented.

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### SECTION V. POTABLE WATER STORAGE

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#### 5-20. General

a. Potable water storage tanks are necessary for fire fighting, to satisfy peak demands, to support uniform water pressure, to meet industrial demands, to provide emergency water reserve, and to avoid continuous pumping.

b. Many installations have oversized potable water storage tanks that exceed their routine capacity requirements. This results in low turnover of the stored water, which may lead to water quality complaints or problems. Many tanks are kept full as a way to be better prepared for emergency conditions. Thus water in storage tanks may be subject to prolong detention times contributing to water quality problems.

c. Typical problems with stored water include:

- (1) Loss of halogen (chlorine) residual.
- (2) Bacterial growth (biofilm).
- (3) Nitrification in systems that use chloramines.
- (4) DBP formation.
- (5) Accumulation of debris and sediment.
- (6) Degradation of tank coatings, materials and plumbing.
- (7) Lack of corrosion control which prematurely ages steel tanks.

d. Water tank openings such as vents, hatches, elevation gauges, and overflows provide access for contaminants from dirt, birds, and other animals to enter the water.

#### 5-21. Maintenance

a. Inspection, maintenance, and repair of storage tanks are essential. Corrosion and scaling in storage tanks may adversely affect the water. All tank coatings (paint), including sealing compounds and other materials shall be certified to NSF/ANSI Standard 61.

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b. Turnover or flushing of the stored water is necessary to minimize detrimental effects on water quality due to long detention times. Increasing water turnover frequency is beneficial in maintaining or restoring disinfectant residual within storage tanks. Turnover is defined as: the average time in hours or days that the entire volume is discharged from the tank. Typically the turnover rate is on the order of once in 3, 5, or 7 days.

c. Cathodic protection systems reduce the natural corrosion reaction that occurs when exposed steel is submerged in water. Fundamentally, cathodic protection introduces a material into the storage facility that will preferentially corrode instead of the steel plates. Cathodic protection can be one of the two types, passive sacrificial or electrified impressed current. Depending on the type, the routine inspection of these systems varies.

### **5-22. Sanitary Standards for Water Storage**

a. When potable water tanks are below ground level:

(1) The overflows, e.g., manhole covers and vents must be located with their tops 6 inches above grade.

(2) The bottom of the tank must be higher (minimum 8 feet) than the water table or floodwater .

(3) The ground around the tank must be sloped away from the tank to provide drainage.

(4) The tanks must be located at a level, which is higher than any sewers or sewage systems.

(5) Sewers or sewage disposal systems must be located at least 50 feet from water storage tanks.

b. Potable Water Tanks

(1) Potable water storage tanks must be covered to prevent contamination by dust, rain, insects, animals, birds, and to discourage algae growth.

(2) All vents and overflows must be screened with 20-mesh bronze insect screens. The vents must be rainproof by using goosenecks or vent caps.

(3) The construction and location of manholes must minimize the possibility of contamination. Manholes (roof hatch) should be designed with a coaming or curb 2 to 6 inches high around the opening. The manhole covers must overlap this coating by at least 2 inches. Except when in actual use, manhole covers should be locked.

(4) Overflow and drainpipes must not be directly connected to sewers.

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(5) Ladders with approved safety cages must be used on all standpipes and elevated storage tanks.

(6) Install a wire fence and locked gate around storage tanks to prevent unauthorized entrance.

c. Before entering any tank or confined space, ensure proper safety precautions have been completed, including atmospheric testing of the confined space, to prevent accidents due to oxygen deficient atmospheres or harmful concentrations of toxic or explosive gases or vapors. Improper entry into confined spaces such as tanks is the cause of numerous preventable deaths.

### 5-23. Disinfection of Water Storage Tanks

a. Potable water tanks should be disinfected as described in the current AWWA Standard C652, "Disinfection of Water Storage Facilities" and UFC 3-230-02, *Operation and Maintenance: Water Supply Systems*. Table 5-23-1 provides a summary of AWWA recommendations for disinfection water storage tanks.

Note: Table 5-23-1 below reads from top to bottom, not left to right.

Table 5-23-1 Summary of AWWA Recommendations For Disinfection Water Storage Tanks		
METHOD 1	METHOD 2	METHOD 3
Fill tank to over flow level	Spray/apply directly 200 ppm FAC to all tank surfaces	Fill 5% of tank volume with 50 ppm FAC solution
Add chlorine to achieve 10 ppm FAC throughout the tank	Flush inlet/outlet pipes with 10 ppm FAC	Hold solution for 6 hours
Hold this solution for 24 hours	Disinfected surfaces shall remain in contact with chlorine solution for a minimum of 30 minutes	Add potable water to chlorine solution to fill tank; hold this water for 24 hours
Drain tank	Refill tank with potable water with required halogen residual level	Drain tank
Refill tank with potable water with required halogen residual level		Refill tank with potable water with required halogen residual level
Perform bacteriological testing of potable water		
Upon satisfactory bacteriological testing and aesthetic quality water may be delivered to the system		

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### SECTION VI. WATER TREATMENT

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**5-24. General.** Water suppliers use a variety of treatment processes to remove contaminants from drinking water. The most commonly used processes include flocculation, sedimentation, filtration and disinfection. Some treatment processes also include ion exchange, reverse osmosis and adsorption. A typical water treatment plant would have only the combination of processes needed to treat the contaminants in the source water used by the facility. For installations which have water treatment plants the PMA should contact the certified water plant operator to obtain a general understanding of the plant operation.

**5-25. Flocculation and Sedimentation.** Flocculation refers to water treatment processes that combine small particles into larger particles, which settle out of the water as sediment. Alum and iron salts or synthetic organic polymers (alone, or in combination with metal salts) are generally used to promote coagulation. Settling or sedimentation is a gravity process that removes flocculated particles from the water.

**5-26. Filtration.** Many water treatment facilities use filtration to remove remaining particles from the water supply. Particles removed include clays, silts, natural organic matter, precipitants from other treatment processes, iron and manganese salts, and microorganisms. Filtration clarifies water and enhances the disinfection efficiency.

**5-27. Ion Exchange.** Ion exchange processes are used to remove inorganic constituents if they cannot be adequately removed by filtration or sedimentation. Ion exchange can be used to treat hard water. It can also be used to remove arsenic, chromium, excess fluoride, nitrates, radium, and uranium.

**5-28. Reverse Osmosis.** Reverse Osmosis (RO) is a process for the removal of dissolved ions. Pressure is used to force water through a semi-permeable membrane, which allows passage of water but excludes dissolved minerals. It is necessary to establish and adhere to strict feed water quality guidelines to optimize water treatment performance and mitigate common problems associated with RO. These problems include scaling, fouling, and degradation of RO membranes.

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In addition, demineralized water, while not a health risk, tends to be corrosive to plumbing fixtures and distribution system components. Facilities where RO is used for drinking water production are urged to evaluate and implement the appropriate corrosion control measures and closely monitor lead and copper levels at consumer taps.

**5-29. Adsorption.** Organic contaminants, color, taste, and odor-causing compounds can be removed by use of granular or powdered activated carbon (GAC or PAC), as it sticks to the surface of these compounds. GAC is generally more effective than PAC in removing these contaminants. Adsorption is not commonly used in public water supplies.

### 5-30. Disinfection (Chlorination, Ozonation)

a. Water is disinfected before it enters the distribution system to ensure that pathogenic microbes are killed. Chlorine, chloramines, or chlorine dioxide are used because they are very effective disinfectants and residual concentrations can be maintained to guard against biological contamination in the water distribution system. Water plant surveillance personnel must ensure that halogen levels are maintained by regular and frequent field testing, both at the point of application and at various points in the water distribution system. Ozone is a powerful disinfectant, but it is not effective in controlling biological contaminants in the distribution pipes because it leaves no disinfectant residual. Ozonation should therefore be followed by chlorination to provide a disinfectant residual in the distribution system. Details on water disinfection requirements including Concentration/Time (CT) requirements may be found in 40 CFR 141.

b. DBPs are formed when disinfectants react with organic matter in treated drinking water. MCL for DBP is set forth in the NPDWR. Long-term exposure to some DBP may increase the risk of cancer or other adverse health effects.

c. Chlorination

(1) Chlorination is the most widely used procedure for the routine disinfection of water. The efficiency of chlorine is affected by the following variables:

(a) The types and concentrations of the chlorine forms present.

(b) The pH of the water. At pH 6.5 and a temperature of 70° F (22°C), 0.3 ppm of chlorine achieves a 100 percent bacterial kill in 60 minutes. With the same temperature and time, at pH 7.0 the chlorine residual must be increased to 0.6 ppm to achieve the same percent of bacterial kill. Data for this pH-chlorine residual relationship are presented in Table 5-30-1.

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Table 5-30-1			
Chlorine-pH Relationship for 100% Bacterial Kill in 60 Minutes (at 72°F)			
Water pH	Chlorine (ppm)	Water pH	Chlorine (ppm)
6.5	0.3	8.5	1.2
7.0	0.6	9.5	1.5
7.7	0.9	10.5	1.8
8.0	1.0		

(c) The type and density of organisms (virus, bacteria, protozoa, etc.) impacts disinfection efficiency. Of all the waterborne diseases, those caused by bacteria are the most easily prevented by chlorine disinfection. At the other extreme, certain pathogenic organisms such as the cysts of the protozoa *E. histolytica*, *Giardia lamblia*, and the oocysts of *Cryptosporidium parvum* are resistant to chlorine.

**(2) Disinfection Requirements (Non-Filtering Systems).** Public water systems that do not provide filtration and use a surface water source or a ground water source under the direct influence of surface water must provide disinfection sufficient to ensure at least 99.9 percent (3 log) inactivation of *Giardia lamblia* cysts and 99.99 percent (4 log) inactivation of viruses every day the system serves water to the public. Information on providing sufficient disinfection to achieve the target inactivation rates may be found in the EPA Surface Water Treatment Rule.

(a) The disinfectant system must have either redundant components, including an auxiliary power supply with an automatic start-up and alarm to ensure that disinfectant application is maintained continuously while water is being delivered to the distribution system, or an automatic shut-off of delivery water whenever there is less than 0.2 ppm of residual FAC disinfectant concentration in the water.

(b) The residual disinfectant concentration entering the distribution system cannot be less than 0.2 ppm for more than 4 hours.

(c) The residual disinfectant concentration in the distribution system, measured as total chlorine, combined chlorine, or chlorine dioxide, cannot be undetectable in more than 5 percent of the samples each month, for any 2 consecutive months that the system serves water to the public. See 40 CFR 141.72(4)(i) for an exception when the use of a heterotrophic plate count, approved by the State, may be used rather than a detectable disinfectant residual for purposes of determining compliance with this requirement.

### **(3) Disinfection Requirements (Filtering Systems)**

(a) Filtered water systems including surface water systems or ground water systems under the direct influence of surface water will provide a combination of disinfection and filtration that achieves a total of 99.9 percent (3-log) removal and/or inactivation of *Giardia lamblia* cysts and 99.99 percent (4-log) removal and/or inactivation of viruses.

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(b) The turbidity of filtered water will be monitored at least once every 4 hours by water plant operators. The turbidity of filtered water will not exceed 0.3 NTU or 1 NTU for slow sand and diatomaceous earth filters, in 95 percent of the analyses in a month, with a maximum of 5 NTU. Elevated turbidity is a sign of a breakdown in treatment processes and may indicate water is not being adequately disinfected.

(c) Disinfection concentration must be sufficient to provide the remaining log-removal of *Giardia lamblia* cysts and viruses not obtained by the filtration technology applied.

(d) Disinfection residual maintenance and monitoring requirements are the same as those for unfiltered systems.

(e) Water supplied to an installation from an approved public water system should have a measurable halogen residual (free available chlorine, total chlorine, chloramines, or chlorine dioxide). When the halogen residual is insufficient, additional disinfection treatment is required.

(3) Potable water systems should be rechlorinated where sanitary, physical, or operating defects or other special hazards are known to exist, or where microbiological examinations show that satisfactory water quality cannot be obtained. Rechlorination should be at a level sufficient to produce a FAC residual of 0.2 ppm after 60 minutes of contact time typically prior to the first customer at the point of entry to the distribution system.

(4) Concern has been generated over the health effects of chlorinated organics. As a result, THMs have been regulated by the SDWA and were placed into the MCLs of NPDWR. THMs are commonly found in chlorinated drinking water, particularly in drinking water obtained from surface sources. THMs are formed by the reaction of naturally occurring organic substances and chlorine during drinking water treatment and distribution.

(5) Either FAC or chloramines residuals are applicable at facilities located in the United States and overseas. Measurement of FAC or chloramines can be determined by using any EPA State-approved method.

### **(6) Chlorination Methods**

**(a) Marginal Chlorination.** In marginal chlorination, the initial chlorine demand has been satisfied but some oxidizable substances remain. The oxidizable substances may be detected by the DPB method as combined chlorine residual. However, it should be noted that the portion of the combined chlorine residual represented by these substances is not a disinfectant.

**(b) Super Chlorination-Dechlorination.** This procedure involves the application of chlorine in greater concentrations than are needed to afford acceptable bactericidal efficiency. This practice gives control over taste and odor producing substances as well as control of bacteria. Surplus chlorine is removed by dechlorination with sulfur dioxide, aeration,

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or activated carbon before the water enters the distribution system. If dechlorination is used, care must be exercised to ensure adequate chlorine residual is present in the water in the distribution system.

**(c) Break-Point Chlorination.** In break-point chlorination, enough chlorine is applied to produce a chlorine residual composed of predominantly FAC with little or no combined chlorine.

**(d) Chloramines (Combined Chlorine and Ammonia).** Chloramines are created by the addition of ammonia to water that contains free chlorine.

**1. Conversion to chloramines benefits.** Chloramines have been successfully used throughout the United States as a secondary disinfectant and are widely accepted as an alternative disinfectant that can be used to comply with increasingly stringent drinking water regulations. The use of chloramines as a secondary disinfectant can reduce disinfection by-product levels, provide a lasting disinfectant residual in the distribution system controls coliforms in accordance with Primacy Agency and Federal regulations, as well as reducing the chlorine taste in the water.

**2. Conversion to chloramine drawbacks include:**

- a.** Potential growth of nitrifying bacteria.
- b.** Adverse taste and odors that can result from blending of water that contains chloramines with water that contains free chlorine.
- c.** Potential adverse impacts on kidney dialysis patients and on tropical fish that need to remove chloramine from water to avoid its toxic effect. This is especially true for at-home dialysis patients. It is suggested that each local dialysis center be contacted to obtain a list of their at-home patients.

**3. Conversion to Chloramine specific requirements.** Effective use of chloramines requires establishing a program that takes advantage of the benefits of chloramines while minimizing the drawbacks associated with its use. Specifically:

- a.** The primary supplier should select the point of ammonia addition downstream of the primary disinfection with free chlorine, chlorine dioxide or ozone and minimize the amount of free ammonia leaving the treatment plant and entering the distribution system.
- b.** The installation should maintain an adequate chloramine residual within the distribution system, taking into consideration that chloramines are weaker disinfectants than free chlorine, it is recommended to maintain a total chlorine residual of 2 mg/L.
- c.** A distribution system Code of Practice should be implemented to provide positive control and feedback on water quality within the distribution system.

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d. A public notification information program by the water supplier should be developed to avoid potential adverse effects on special water users such as kidney dialysis patients, tropical fish, etc.

### 5-31. Fluoridation

a. When optimum amounts of fluorides are not naturally present in drinking water, the application of fluoride to water supplies is a long standing and current public health recommendation to help prevent dental caries. BUMED concurs with this position. Although drinking water fluoridation is not regulated it is endorsed by EPA and Centers for Disease Control and Prevention (CDC), which has determined that the “optimal” range of fluoride in water lies between 0.7-1.2 mg/L (ppm), depending on the mean daily air temperature of a geographic area. The MCL for fluoride in drinking water is 4 ppm because of evidence that in extreme cases, exposure to drinking-water fluoride levels over 4 ppm for many years may result in skeletal fluorosis, a serious bone disorder. A secondary standard of 2 ppm has been established because some children exposed to fluoride levels greater than 2 ppm may develop dental fluorosis, an unsightly cosmetic discoloring or mottling of the enamel, visible by chalky white specks and lines or pitted and brown-stained enamel on permanent, adult teeth.

b. For overseas installations consult the *Final Governing Standards* or the *Overseas Environmental Baseline Guidance Document* for fluoridation requirements as applicable.

**5-32. Corrosion Control.** Corrosion is a phenomenon associated with a metal and the water within a distribution system. Physical factors that affect corrosion and corrosion control are temperature, velocity of water moving over the metal, changes in direction and velocity of flow, and contact with a second metal or nonmetal. Water pH may also be a significant corrosion factor. Installations that are considering converting from free chlorine to chloramines for residual disinfection or whose primary supplier is considering such a change should be aware that chloramines have been implicated in recent occurrences of high lead levels. In addition, there is evidence that changes in treatment chemicals, such as converting from the use of aluminum sulfate to a polyaluminum chloride; as a coagulant for surface water treatment may alter the chloride to sulfate ratio sufficiently to increase the rate of corrosion with respect to lead.

### 5-33. Point of Use (POU) and Point of Entry (POE) Treatment

a. EPA has approved centrally managed POU and POE treatment devices as a means to achieve compliance with MCLs. POU devices treat only the water intended for direct consumption at a single tap, while POE devices are typically installed to treat all water prior to entering a building/dwelling.

b. POU and POE treatment strategies may be useful for selected public water systems as an interim measure or, when constructing, upgrading, or expanding a central water treatment plant is not a viable option. States that have Primacy (i.e., regulatory oversight authority for the Safe Drinking Water Act) may have restrictions regarding use of these treatment strategies. Therefore, any POU/POE treatment compliance strategies must be co-coordinated with all applicable approval authorities, both military and civilian, as applicable.

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- c. POU treatment units shall not be used to achieve compliance with an MCL or treatment technique for a microbial contaminant or an indicator of a microbial contaminant. However, POE devices may be used to achieve compliance with an MCL for a microbial contaminant or an indicator of a microbial contaminant.
- d. POU and POE units must be owned, controlled, and maintained by the public water system or by a contractor hired by the public water system to ensure the proper operation, maintenance of devices, and compliance with the MCLs. Important considerations are correct installation, maintenance, and sampling of the water treatment device. To satisfy baseline data requirements, an initial water sample analysis shall be carried out to verify the POU/POE device is working as designed. The system owner retains final responsibility for the quality and quantity of the water provided to the service community and must closely monitor all contractors. The applicable authorities shall approve periodic sampling plans for compliance monitoring.
- e. Manufacturers and companies which make or market water vending machines for the purpose of treatment or reduction of a health or aesthetic contaminants shall provide documentation that all treatment (wetted) components of the water vending machine have been certified via the applicable NSF/ANSI Standard by the manufacturer using an established third party accredited laboratory.
- f. POU and POE units must have mechanical warnings to automatically notify customers of operational problems.
- g. Only NSF/ANSI third party certified POU and POE treatments devices shall be used as part of a compliance strategy if a standard exists for that type of treatment device. Table 5-33-1 provides information on NSF/ANSI Drinking Water Treatment Unit Standards.

<b>Table 5-33-1</b> <b>NSF/ANSI Industry Standards Drinking Water Treatment Unit</b>
42: Drinking Water Treatment Units – Aesthetic Effects
44: Cation Exchange Water Softeners
53: Drinking Water Treatment Units – Health Effects
55: Ultraviolet (UV) Microbiological Water Treatment Systems *
58: Reverse Osmosis Drinking Water Treatment Systems
62: Drinking Water Distillation Systems

\* The use of POU devices for microbiological contaminants water quality compliance is forbidden in the Safe Drinking Water Act. Therefore, although POU UV devices may be certified under NSF/ANSI Standard 55, they shall not be considered when identifying potential compliance technologies for SDWA.

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### SECTION VII. WATER QUALITY STANDARDS

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#### 5-34. Water Quality Standards

**a. General.** National Drinking Water Standards are periodically amended or revised. The latest EPA water quality standards are posted on the U.S. EPA Web site. Appendix D provides additional information. For Drinking Water Quality Standards for DoD overseas installations (OCONUS) consult the *Final Governing Standards* or the *Overseas Environmental Baseline Guidance Document* when Final Governing Standards have not been established.

**b. Physical Quality.** The principal physical characteristics of water are color, odor, and turbidity. Temperature may also be considered a physical quality. The basis for physical quality standards is primarily related to consumer acceptance of the water.

**c. Chemical Quality.** All the chemical constituents present and interactions between these constituents determine the chemical quality of water. The chemical quality of the water may be described in terms of inclusive characteristics, e.g., total hardness, alkalinity, and pH, or it may be described in terms of a particular cation or anion, e.g., arsenic, barium, or calcium.

#### d. Microbiological Quality

(1) The microbiological quality of drinking water indicates its potential for transmitting waterborne diseases. Total coliform bacteria organisms are used as the indicators to determine if treated water is safe to consume. Total coliform bacteria are typically either: *Escherichia coli*, *Klebsiella pneumonia*, and *Enterobacter aerogenes* organisms. The presence of total coliform bacteria may be an environmental contaminant and not necessarily the result of fecal contamination. On the other hand, fecal coliforms, specifically *Escherichia coli* are a subset of coliform bacteria and their presence indicates the water source may have been contaminated with pathogenic organisms. Presence of *E. Coli* is an acute water quality violation requiring immediate action. These organisms occur in large quantities in the intestines of warm-blooded animals and are used as presumptive evidence of fecal contamination of water. Total coliform without the presence of fecal coliforms may indicate a distribution (biofilm) problem. The presence of total coliform organisms in treated drinking water is an indicator of either inadequate disinfection treatment or the introduction of contaminants to the water after treatment such as maybe attributed to biofilm growth. Presence of total coliforms is a water quality violation and requires water supplier take immediate corrective action as set forth by State and Federal law.

(2) Microbiological examinations of potable water are conducted to show either the presence or absence of the coliform group. Any EPA-approved testing methods may be used. The HPC formerly the standard plate count is not required by NPDWR for bacteriological surveillance monitoring. Its use may be needed in water treatment plants in conjunction with

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modification of the turbidity limit. HPC testing is often done when a biofilm problem exists. The HPC provides the number of bacteria organisms that can grow under the conditions of the test. It has varying significance for finished water, particularly if the plating is not completed within 6 hours after collection of the sample. The test is valuable in finding the microbiological efficiency of the various units in a water treatment process. Excessively high counts may indicate a contamination problem in the system and warrant further investigation. In addition, high HPC counts may hinder the recovery of coliforms. Appendix E provides additional information.

**e. Radiological Quality.** Radiological water quality standards are based on the premise that any unnecessary exposure must be avoided. The physiological effects that are associated with overexposure to radiation demands the rejection of any treated water containing excess quantities of radionuclides. Proper treatment methods will provide drinking water of desired radiological quality in most cases. The NPDWR Standards for radiological water quality may be found on the EPA Web site.

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### SECTION VIII. WATER QUALITY SURVEILLANCE

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**5-35. General.** The objectives of water quality compliance monitoring are to verify that the quality of drinking water on the Navy and Marine Corps installations meets the minimum health standards of NPDWR. These objectives are met by a program of water quality monitoring and testing by certified laboratories under the direction of NAVFAC. For overseas installations refer to the *Final Governing Standards or Overseas Environmental Baseline Guidance Document* as applicable for drinking water quality standards. Naval Facilities Engineering Command User's Guide, UG-2077-ENV, *Potable Water Quality Management Guidance Document* (September 2007), provides direction and information for meeting compliance requirements for the Safe Drinking Water act and its related rules for both primary and consecutive Navy and Marine Corps drinking water installations. A copy of this publication may be found on the Navy and Marine Corps Public Health Center's Web page at: <http://www-nehc.med.navy.mil/prevmed/eh/downloads/UG-2077-ENV%20PWQM%20Guidance.pdf>.

#### 5-36. Consecutive and Non-Public Water Systems

a. Consecutive water systems. Military installations in CONUS generally obtain water from an approved municipal water plant. OPNAVINST 5090.1 series and MCO 5090.2 series defines a consecutive water system as a water system which has no water production or source facility of its own and which obtains all of its water from another water system. Consecutive water systems shall perform sampling and testing to comply with applicable Regulatory authority. Further guidance is provided in Naval Facilities Engineering Command User's Guide, UG-2034-ENV, *Consecutive Water System Guidance Document for Navy Shore Installations Users' Guide* (January 1999). Consecutive water systems are not subject to requirements of the SDWA if they satisfy the following requirements:

- (1) Consist of distribution and storage facilities only and provide no treatment.
- (2) Obtain all drinking water from a regulated water supplier.
- (3) Do not sell drinking water.

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(4) Do not provide water to commercial carriers conveying passengers in interstate commerce.

b. The consecutive water system would, at a minimum, be required to comply with requirements pertaining to those contaminants which could be contributed by the consecutive PWS distribution system downstream of the point of connection to the regulated PWS. As specified in Section 8 of OPNAVINST 5090.1 series, regardless of variances and exemptions from regulatory monitoring, shore facilities that own and operate a consecutive water system shall perform the following monitoring:

- (1) Bacteriological monitoring.
- (2) Asbestos.
- (3) Lead in priority areas.
- (4) Lead and Copper in water systems.
- (5) Review of primary PWS records.

**5-37 Water Quality Standard Compliance.** Federal Drinking Water Quality Standards for the SDWA are found in 40 CFR 141. Regulatory compliance may be achieved in one of two ways: applying a required treatment technique to control or remove regulated contaminants, or providing water quality meeting all drinking water MCLs, Action Levels (AL) (in the case of lead and copper) and Secondary Maximum Contaminant Level (SMCL) when required by the Primacy Agency. Before establishing an MCL, the EPA considers the best available technologies for removing the contaminant, analytical technologies for monitoring the contaminant, and the cost of both. A balance is made between the cost to the consumer and the reduction of the risk to consumer health. This cost- benefit analysis attempts to achieve a risk to human health that is no greater than one in a million, e.g., the added threat of the contaminant at that level would cause no more than one extra cancer or adverse health effect per million people, each drinking two liters of water per day during a 70-year lifetime. Exceeding the AL for lead or copper requires a water system to take action to reduce the leaching problem within the system and to educate and protect the consumer from exposure to lead and copper from drinking water. The EPA establishes each MCL upon the contaminant's MCLG (maximum contaminant level goal) that is the level of a contaminant in drinking water at which no known or anticipated adverse health effects are expected to occur. The MCLGs are not federally enforceable but are a more desirable limit.

**5-38. Compliance Monitoring.** Naval installations operating water systems shall comply with all applicable Federal, State, and local safe drinking water regulations, Executive Orders, and Department of Navy policy. Drinking water quality is monitored by the water supplier (PWC) using certified laboratories to ensure all applicable MCLs are met. EPA established a Standardized Monitoring Framework to reduce the variability and complexity of drinking water monitoring requirements. The framework synchronizes the monitoring schedule for source-related

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contaminants associated with the chronic health effects, e.g., VOCs, pesticides, herbicides, radionuclides, and inorganic other than nitrate/nitrite. Violations of MCLs require the water purveyor to submit Public Notifications as applicable.

**5-39. Analytical Requirements.** All compliance monitoring for drinking water analyses for SDWA (EPA) compliance must be conducted by State certified laboratories. All certified laboratories must conduct analyses using EPA-approved test methodologies, and follow water control requirements for testing all water samples as set forth in 40 CFR 141 and 143.

### 5-40. Lead Contamination Control Act and Lead and Copper Rule

**a. The Lead Contamination Control Act** was passed as an amendment to the SDWA in October 1988. It was designed to minimize children's exposure to lead from drinking water in schools and day care centers. A major provision of this Act required the EPA to publish a list of drinking water coolers that are not lead free. On 10 April 1989, this list was published in 54 FR 14320 and updated on 18 January 1990 in 55 FR 1772. The Lead Contamination Control Act also required States to provide a guidance document and testing protocol to assist schools to determine the source and amount of lead contamination in school drinking water and in controlling such contamination. The EPA published a guidance document, Sampling for Lead in Drinking Water in Nursery Schools and Day Care Facilities.

**b. Lead and Copper Rule.** This rule was finalized in June 1991 with corrections/revisions in July 1991, June 1992, June 1994, and January 2000. It is published in 40 CFR 141, Subpart I.

**(1) Lead and copper concentrations.** Almost all lead and copper concentrations in water systems results from leaching of the metals from water service lines and internal plumbing materials rather than contaminated source water. Corrosive water allows leaching of lead and copper from the distribution system. The rule requires monitoring for lead and copper at the consumer's water tap (sink taps, not drinking fountains). ALs rather than MCLs were established for lead (0.015 mg/L) and copper (1.3 mg/L) in drinking water. First draw samples (water standing in the tap for at least 6 hours) are collected by catching the first water (one-liter) that comes from the tap and not allowing any flushing or wasting of the water. Action levels are not exceeded if 90 percent of the first draw samples fall below 0.015 mg/L for lead and 1.3 mg/L or for copper. Sampling sites may not include faucets that have POU or POE approved treatment devices designed to remove inorganic contaminants.

**(2) Monitoring.** The lead and copper rule has a monitoring schedule for large systems (serving more than 50,000 people), medium systems (serving 3,301 - 50,000 people), and small systems (3,300 or less people). Initial monitoring for the *Lead and Copper Rule* occurs for two consecutive 6-month monitoring periods, although small and medium systems that exceed the action levels during the first 6-month monitoring period need not sample for a second 6-month monitoring event. Schedules for continued monitoring depend upon the results of the first two monitoring period. The *Lead and Copper Rule* requires water systems to monitor lead and copper content at the consumer's taps within homes and work places. The number of samples required is determined by the number of people served by the system. Table 5-40-1 provides

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sampling protocol. The location of samples must be chosen according to specific criteria as defined by the rule. Targeted locations are divided into Tiers 1, 2, and 3. See Table 5-40-2. Water systems unable to get all required samples from Tier 1 sites must have the sample site plan approved by the Primacy Agency.

<b>Table 5-40-1</b> <b>Number of lead and copper samples required</b>		
<b>Population Served</b>	<b>Standard Number of Samples</b>	<b>Reduced Number of Samples</b>
>100,000	100	50
10,001 to 100,000	60	30
3,301 to 10,000	40	30
501 to 3,300	20	10
101 to 501	10	5
$\leq 100$	5	5

<b>Table 5-40-2</b> <b>Tier Definitions</b>	
<b>Tier</b>	<b>Sites Include</b>
Tier 1	Single family structures* that: 1. Contain copper pipes with lead solder installed after 1982 or lead pipes 2. Served by lead service lines
Tier 2 **	Buildings or multi-family structures that: 1. Contain copper pipes with lead solder installed after 1982 or lead pipes 2. Served by a lead service line
Tier 3	Single family structures* that contain copper pipes with lead solder installed before 1983

\* For community water systems whose area served consist of more than 20 percent multi-family residences, these structures may be included in the sampling pool.  
 \*\* Non-transient, non-community water systems (NTNCWS) will consider Tier 2 as Tier 1 for the sampling pool. Tier 3 then becomes Tier 2.

(3) **Water Quality Parameters.** Additional monitoring for distributed water quality characteristics (pH, alkalinity, orthophosphate, silica, calcium, conductivity, and temperature) must be conducted by all large systems. Small and medium systems must monitor water quality parameters when the action levels for lead and copper are exceeded. See Table 5-40-3 for the number of water quality characteristic samples required. Monitoring is required at two locations: (1) representative taps throughout the distribution system, and (2) entry points to the distribution system. All large water systems and those small and medium-size water systems that exceed the lead or copper action level must collect two tap samples for each applicable water quality constituent during each 6-month monitoring period. In addition, one sample must be collected for each applicable water quality constituent at each entry point to the distribution system every 2 weeks. After installing optimal corrosion-control treatment, systems must continue to collect two samples from each specified sampling site every 6 months and one sample for each applicable water quality constituent at each entry point to the distribution system every 2 weeks. All water systems that maintain State-specified water quality for optimal corrosion control for two consecutive 6-month monitoring periods may reduce the number of tap samples collected

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during each 6-month monitoring period. Systems that maintain State-specified levels of water quality, reflecting optimal corrosion control for 3 consecutive years may reduce the number of tap samples collected and the frequency at which the tap samples are collected to once a year.

**(4) Guidance.** The EPA published a detailed document, *Lead and Copper Rule Guidance Manual Volume I: Monitoring*, describing the steps involved in compliance monitoring which should be consulted when beginning to address the *Lead and Copper Rule*.

Table 5-40-3 Number of water quality samples required		
Population Served	Standard Number of Samples	Reduced Number of Samples
$\geq 100,000$	25	10
10,001 to 100,000	10	7
3,301 to 10,000	3	3
501 to 3,300	2	2
101 to 501	1	1
$\leq 100$	1	1

**(5) Treatment Techniques.** Systems that exceed the lead and/or copper action level in either the initial 6-month monitoring periods must begin corrosion control treatment. Guidance for corrosion control studies may be found in the EPA Manual, Lead and Copper Rule Guidance Manual Volume II: Corrosion Control Treatment.

**(6) Reporting Requirements.** Up to five basic elements may have to be reported to the Primacy Agency under the Lead and Copper Rule: tap water sampling results for both lead and copper and water quality parameters; source water monitoring results; treatment technique application results (corrosion control, source water treatment, and lead service line replacement); public education program demonstration; and results of any additional lead and copper or water quality samples taken by the system. Monitoring must be reported within the first 10 days of the end of the monitoring period.

**(7) Public Education Programs.** The importance of public education programs is not just to remain in compliance with the *Lead and Copper Rule*, but also to protect the health of the consumers. The rule has very specific required text and content for a publication education program that is detailed in the rule. See *40 CFR -141, Subpart I*.

**c. Lead and Copper Rule Minor Revisions (LCRMRs).** On 12 January 2000, EPA made minor revisions to improve implementation of the LCR by eliminating unnecessary requirements and reducing the burden for public water systems. The LCRMRs do not change the action levels established in 1991 and do not affect the rule's basic requirements to optimize corrosion control, treat source water, deliver public education and replace lead service lines. For a water system, which serves fewer than 3,300, the LCRMR provide with more flexibility in the mode of delivery for public education, should that become necessary. Also, the LCRMR allow systems which do not have enough taps where the water has stood motionless for at least 6 hours

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to collect samples from taps with the longest standing times. For further details, consult the “Lead and Copper Monitoring and Reporting Guidance for Public Water Systems” which was issued by EPA in February 2002 and is available online from <http://www.epa.gov>.

- d. In general, POU and POE devices (e.g., activated carbon filters, sand filters, and cartridges or micro-filters) will not reduce lead and copper. Reverse osmosis and distillation can reduce the concentration of lead and copper in the water entering the unit but these treatment processes produce highly aggressive water that, by itself, can leach lead from downstream plumbing fixtures. In addition, it should be noted that the LCR does not allow sampling from sinks where POU or POE devices have been installed.
- e. OPNAVINST 5090.1 series requires that all water coolers and outlets located in priority areas be tested for lead.

### **5-41. Surface Water Treatment Rule (SWTR)**

a. SWTR is published in 40 CFR 141, Subpart H. The SWTR applies to all PWS that use surface water or ground-water source that is determined to be under the direct influence of surface water. The State has the responsibility to determine whether or not ground-water systems are under the direct influence of surface water and provide proper notification. Compliance with the rule can become very complex. EPA publication, Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface water Sources, contains the exact regulatory requirements. Three rules were subsequently promulgated which built on the requirements of the SWTR and added treatment and monitoring measures to strengthen existing standards and improve protection from waterborne pathogens for all water systems.

b. The SWTR (published 29 June 1989/effective 31 December 1990) seeks to prevent waterborne diseases caused by viruses, *Legionella*, and *Giardia lamblia*. These disease-causing microbes are ubiquitous at varying concentrations in most surface waters. The rule requires that water systems filter and disinfect water from surface water sources to reduce the occurrence of unsafe levels of these microbes.

#### **c. The Enhanced Surface Water Treatment Rule (ESWTR)**

(1) The ESWTR issued on December 16, 1998 applies to systems using surface water, or ground water under the GWUDISW that serve 10,000 or more persons. The rule also includes provisions for a Primacy Agency to conduct sanitary surveys for surface water systems regardless of system size. The rule builds upon the treatment technique requirements of the SWTR with the following key additions and modifications:

- (a) Maximum contaminant level goal (MCLG) of zero for *Cryptosporidium*.
- (b) 2-log *Cryptosporidium* removal requirements for systems that filter.
- (c) Strengthened combined filter effluent turbidity performance standards.

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- (d) Individual filter turbidity monitoring provisions.
  - (e) Disinfection profiling and benchmarking provisions.
  - (f) Systems using GWUDISW now subject to the new rules dealing with *Cryptosporidium*.
  - (g) Inclusion of *Cryptosporidium* in the watershed control requirements for unfiltered public water systems.
  - (h) Requirements for covers on new finished water reservoirs.
  - (i) Sanitary surveys, conducted by a Primary Agency, for all surface water systems regardless of size.
- (2) The ESWTR, with tightened turbidity performance criteria and required individual filter monitoring, is designed to optimize treatment reliability and to enhance physical removal efficiencies to minimize the *Cryptosporidium* levels in finished water. In addition, the rule includes disinfection benchmark provisions to assure continued levels of microbial protection while facilities take the necessary steps to comply with new DBP standards.

### **5-42. Public Notification and Consumer Confidence Reporting (CCR)**

- a. Sometimes, the drinking water produced does not meet the criteria to be considered safe, as determined by regulations of the Safe Drinking Water Act. In these cases, the consumer must be notified of the concern and what he can do to protect himself. The EPA has established Public Notification reporting criteria for all SDWA violations. The issuance/release of Public Notification and/or Consumer Confidence Reports is the water purveyor (Public Works) responsibility. However, the PMA needs to be kept informed of drinking water quality violations and concerns in order to assist with risk communication. The local PMA may request risk communication and other preventive medical assistance from commands listed in Appendix C.
- b. Since the regulations of the SDWA range from protection of health (compliance with MCLs and treatment techniques) to administrative requirements (monitoring at certain times, issue of variance exemptions, use of particular analytical techniques), the public notification requirements are divided into two tiers. Tier 1 violations may affect the health of the consumer and have more stringent requirements. These notifications must use certain verbiage called "mandatory health effects language." The language for each contaminant regulated by EPA is found in 40 CFR 141. Tier 2 violations are less serious and have less stringent public notification requirements.
- c. General Content and Distribution of Public Notice. The EPA requires certain information to be included in all public notices, such as mandatory health effects language for Tier 1 violations, the phone number of a point of contact regarding the issue, and what the system is doing to correct the problem. The format of the notification must meet certain specifications, designed to be useful to the majority of the population served. The media type

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used and the frequency of distribution are also governed. EPA Guidance Manual, *General Public Notification for Public Water Systems*, or 40 CFR 141, Subpart D should be consulted when confronted with any public notification requirements.

### 5-43. Safe Drinking Water Act Amendments of 1996

a. The Safe Drinking Water Act Amendments of 1996 (PL 104-182), established a new charter for the nation's public water systems, States, and the EPA in protecting the safety of drinking water. The amendments may be found on the EPA Web site <http://www.epa.gov>. The SDWA amendments include, among other things; new prevention approaches, improved consumer information, changes to improve the regulatory program, and funding for States and local water systems.

b. Probably the first portion of the Safe Drinking Water Amendments of 1996 to impact on existing and new Navy and Marine corps community water systems is the requirements for CCRs. Essentially this requires Navy and Marine corps owned community water systems to report to their consumers the number and types of contaminants that are in their drinking water, as well as other vital public health required quality information on an annual basis. Complete reporting requirements may be found on the EPA Web site <http://www.epa.gov>. EPA has developed a computerized fill-in-the blank template that water systems will be able to use if they are unable or do not choose to develop their own consumer confidence report format. The report must include the following:

(1) The source of the water purveyed.

(2) A brief and plainly-worded definition of the terms maximum contaminant level goal, maximum contaminant level, variances, and exemptions.

(3) If any regulated contaminant is detected in the water purveyed by the community water system, a statement setting forth: the maximum contaminant level goal; the maximum contaminant level; the level of such contaminant in the water system; and for any regulated contaminant for which there has been a violation of the maximum contaminant level during the year covered by the report, a brief statement in plain language regarding the health concerns that resulted in the regulation of that contaminant.

(4) Information on compliance with National Primary Drinking Water Regulations and a notice if the system is operating under a variance or exemption and the basis on which the variance or exemption was granted.

(5) Information on the levels of unregulated contaminants for which monitoring is required including *Cryptosporidium* and radon where Primacy Agency determines they may be found.

(6) A statement that the presence of contaminants in drinking water does not necessarily indicate that the drinking water poses a health risk and that more information about contaminants and potential health effects can be obtained by calling the Safe Drinking Water Hotline.

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### SECTION IX. CONTINGENCY/VULNERABILITY PLANNING

<u>Article</u>	<u>Subject</u>	<u>Page</u>
5-44	General -----	5-49
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#### **5-44. General**

a. The management and operation of a public water system is a complex task with the objective of providing a continuous, high quality and safe source of water supply during natural and/or manmade disasters. Water suppliers must be able to ensure that adequate supplies of water are delivered to satisfy consumer demand at sufficient pressure, palatability and most importantly safe for human consumption. Drinking water supply systems, especially treatment and distribution/storage facilities, may present targets of opportunity for physical destruction, intentional contamination, or cyber attack by terrorists. Preventive Medicine personnel have a keen interest in medical surveillance of the water system because history has shown that contaminated water can be a significant vehicle for spread of infectious diseases and other waterborne agents. Preventive Medicine Personnel will play a critical role in an emergency response action for any water contamination event. To this end, Preventive Medicine personnel may be consulted in regards to the ongoing development, review, implementation of a contingency plan regarding preparedness and response for water contamination issues. In the event of a criminal attack on a water system the applicable law enforcement agency has lead but may require preventive medicine assistance.

b. SECNAVINST 3300.2 series implemented the Navy's Antiterrorism (AT) Program. Water vulnerability assessment is one element of the AT Program. Public Works (NAVFAC) is the lead for water vulnerability assessments per established lanes of responsibility. However, the PMA should be knowledgeable of the report since the PMA no doubt will play a critical role in any emergency response. Generally, installations utilize water from either ground or surface water sources (or a combination of both). Some locations control the source of their water, while others purchase their supply from another entity. Some installations have their water source located within the military geographical boundaries, while others do not. In development of an installation contingency/vulnerability plan all factors should be considered.

#### **5-45. Points to Consider**

a. Physical destruction, biological/chemical contamination, and cyber attack are examples of methods that could effect the operation of the public water system. A water vulnerability assessment is one aspect of the AT Program. Public Works is generally the responsible party for oversight of the water vulnerability assessment. While this assessment is not a responsibility of the local PMA he or she should contact the water purveyor to become familiar with contents of this report. In the event of an emergency the PMA will no doubt have a response role. Some of the basic preparedness planning factors are listed below:

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- (1) Current listing of telephone numbers for all key personnel, including an emergency notification recall.
  - (2) Plans and procedures for emergency response.
  - (3) A current water systems facilities map with directional flow, including major valves and backflow prevention devices for isolating damaged/contaminated areas.
  - (4) Listing of certified laboratories with analytical capabilities. Specialized analyses considerations may be warranted.
  - (5) Alternative emergency water approaches—e.g., boiling, bottled water, temporary treatment equipment, and hauled-in supplies.
  - (6) Review of vulnerability of water system points for security intervention considerations.
  - (7) Education efforts to impress waterworks personnel to report any observed abnormal conditions.
  - (8) Consideration of enhanced monitoring by waterworks personnel during periods of increased threats. Measurements of routine parameters such as pH, turbidity, conductivity, and chlorine residual (location, frequency) should be expanded. Loss of water pressure may heighten concerns for contamination by cross-connections.
  - (9) Consideration for prioritizing water distribution system areas for maintaining water supply and pressure.
  - (10) Protection of any automated equipment and system control and data acquisition (SCADA) from cyber attack.
- b. The effectiveness of an emergency response is directly proportional to the care in which the contingency plan has been prepared. However, as with any contingency plan, action responses may change due to changes and additional insults to the potable water system.

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### **Appendix A**

#### **MODEL POTABLE WATER SURVEILLANCE PROGRAM FOR INSTALLATION PREVENTIVE MEDICINE AUTHORITY**

- Coordinate liaison for routine and emergency communication with Public Works/water purveyor.
- Write a Standard Operating Procedure detailing the PMA potable water-surveillance program. Keep an updated list of all water resources.
- Maintain current Public Works other key installation emergency points of contact, including after hour information.
- Keep copies of all regulatory agency and Navy and Marine Corps water regulations, instructions, and orders.
- Collect samples for bacteriological testing in response to consumer complaints and outbreak investigations. Public Works is responsible for ongoing microbiological compliance monitoring as required by the Safe Drinking Water Act. (For overseas installations the PMA may have an increased microbiological surveillance responsibility).
- Perform halogen (chlorine) residual tests to investigate water problems (e.g., taste and odor, consumer complaints, and with each above bacteriological analyses). Public Works is responsible for compliance monitoring.
- Verify Public Works is conducting compliance monitoring using certified laboratories and issuing Consumer Confidence Reports & Public Notifications when applicable.
- When the water source, treatment plant, storage and distribution system are located on the installation, coordinate joint quarterly inspection with Public Works.
- Provide assistance when requested to Public Works to ensure that all chemicals which are direct and/or indirect additives to potable water supplies are as listed in NSF/ANSI Standards No. 60 and 61 respectively.
- Verify from Public Works that water treatment plant laboratory has a quality assurance and quality control program and is State/EPA-certified.
- Verify that Public Works has established a cross-connection control program.
- Verify Public Works has a continuing education/training program for all personnel working with the potable water system.
- Verify the installation has completed a water vulnerability assessment/emergency response plan and PMA is familiar with the plan.

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### Appendix B

#### ABBREVIATIONS/DEFINITIONS

**ACUTE HEALTH EFFECT** - An immediate (i.e., within hours or days) adverse health effect that may result from exposure to certain drinking water contaminants (e.g., pathogens).

**AIRGAP** - A physical separation sufficient to prevent backflow between the free-flowing discharge end of a potable water system outlet and any other system. An air gap is physically defined as a distance equal to twice the diameter of the outlet, but never less than 1 inch.

**AL - ACTION LEVEL** - The level of lead or copper which, if exceeded in over 10 percent of the samples tested, triggers treatment or other requirements that a water system must follow.

**ANSI** - American National Standard Institute.

**AQUIFER** - A permeable, water-bearing geologic formation.

**AT** – Antiterrorism.

**AWWA** - American Waterworks Association.

**BACKFLOW** - The flow of non-potable water or other liquids, mixtures, or substances into the potable water supply system. Backsiphonage and backpressure are the two types of backflow.

**BACKFLOW PREVENTION DEVICE** - A device or means designed to prevent backflow or backsiphonage. Most commonly categorized as air gap, reduced pressure principle device, double check valve assembly, pressure vacuum breaker, atmosphere vacuum breaker, residential dual check, double check with intermediate atmosphere vent, and barometric loop. An air gap is the preferred method for backflow prevention but not always practical.

**BACKSIPHONAGE** - Backflow resulting from negative pressure in the distribution pipes of a potable water system.

**CCR** - Consumer Confidence Report, (required when MCL violation exist).

**CDC** - Centers for Disease Control and Prevention.

**CFR** - Code of Federal Regulation.

**CHECK VALVE** - A self-closing device that is designed to allow the flow of fluids in one direction and to close if there is a reversal of flow.

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**CHLORAMINE** - An alternative means of disinfection often used to try to reduce disinfection by-products formation. The chlorine products formed by the reaction of equilibrium products of ammonia with the equilibrium products of chlorine to form chloramines. Combined available chlorine (chloramine) has significantly less disinfecting power than chlorine.

**CHRONIC HEALTH EFFECT** - The possible result of exposure over many years to a drinking water contaminant at levels above its maximum contaminant level (MCL).

**COLIFORM** - A group of related bacteria whose presence in drinking water may indicate contamination by disease-causing micro-organisms or environmental contaminants.

**COMMUNITY WATER SYSTEM** - A public water system that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

**COMPLIANCE MONITORING** - (1) Drinking water analysis by a State accredited laboratory using EPA-approved methodology. (2) The act of meeting all State and Federal drinking water regulations.

**CONTAMINANT** - Anything found in water (including microorganisms, minerals, chemicals, radionuclides, etc.) which may be harmful to human health.

**CONUS** - Continental United States.

**COTS** - Commercial Off The Shelf.

**CROSS CONNECTION** - Any actual or potential connection between the public water supply and a source of contamination or pollution.

**CROSSOVER POINT** - Any point or points where a potable water main makes contact or crosses over or under a non-potable liquid conduit (sewer, non-potable water supply, etc.).

**CRYPTOSPORIDIUM** - A microbe commonly found in lakes and rivers which is highly resistant to disinfection. *Cryptosporidium* has caused several large outbreaks of gastrointestinal illness, with symptoms that include diarrhea, nausea, and/or stomach cramps. People with severely weakened immune systems are likely to have more severe and more persistent symptoms than healthy individuals.

**CT - CONCENTRATION/TIME** - EPA specifies CT values for each disinfectant at defined pH levels and temperatures; for many disinfectants, microbial inactivation is both pH and temperature dependent. It is the product of disinfectant concentration (C) (measured in mg/L) and contact time (T) (measured in minutes) using a particular disinfectant to achieve a certain degree of *Cryptosporidium*, *Giardia* and/or virus reduction. CT units are measured in mg-min/L.

**DBP - DISINFECTANT BYPRODUCT** - Chemicals that may form when disinfectants (such as chlorine), react with plant matter and other naturally occurring materials in the water. These byproducts may pose chronic health risks in drinking water.

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**DISINFECTANT** - A chemical (commonly chlorine, chloramines, or ozone) or physical process (e.g., ultraviolet light) that kills microorganisms such as bacteria, viruses, and protozoa.

**DISINFECTION** - A process that inactivates pathogenic organisms in water by chemical oxidants or equivalent agents.

**DoD** - Department of Defense.

**DoDD** - Department of Defense Directive.

**DON** - Department of Navy.

**EPA** - U.S. Environmental Protection Agency.

**ESWTR** - Enhanced Surface Water Treatment Rule.

**FAC - FREE AVAILABLE CHLORINE** - Chlorine available (after chlorine demand has been satisfied) in the forms of hypochlorous acid and hypochlorite ions.

**FGS** - Final Governing Standard Drinking Water Quality Standards OCONUS installations.

**FIELD WATER SUPPLY SYSTEM** - A system of collection, purification, storage, transportation, distribution equipment, and personnel to provide drinking water to field units in training or in actual deployment environments. ROWPU are used for treating water for deployed units. Field Water Systems are not subject to requirements of the Safe Drinking Water Act or EPA regulations. Tri-Service Drinking Water Quality Standards have been established for DoD field water sources.

**FILTRATION** - A process for removing particulate matter from water by passage through porous media.

**GAC** - Granular Activated Carbon.

**GASTROENTERITIS** - A general category of gastrointestinal illness which may result from drinking water contaminated with pathogenic viruses, bacteria, or protozoa. Symptoms include diarrhea, cramps, fatigue, nausea and vomiting.

**GIARDIA LAMBLIA** - A microorganism frequently found in rivers and lakes, which, if not treated for properly, may cause diarrhea, fatigue, and cramps after ingested.

**GWUDISW** - Ground Water Under The Direct Influence Of Surface Water - Any water beneath the surface of the ground with: (1) significant occurrences of insects, microorganisms, algae, or large diameter pathogens such as *Giardia lamblia*, or; (2) significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions. Direct influence must be determined for individual

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sources in accordance with criteria established by the Primacy Agency. The Primacy Agency determination of direct influence may be based on site-specific measurements of water quality and/or documentation of well construction characteristics and geology with field evaluation.

**HEALTH HAZARD** - Any condition, including any device or water treatment practice that may create an adverse effect on a person's health and well being.

**HPC** - Heterotrophic Plate Count.

**INORGANIC CHEMICALS** - Mineral-based compounds such as metals, nitrates, and asbestos. These contaminants are naturally-occurring in some water, but can also get into water through farming, chemical manufacturing, and other human activities.

**IOCs** - Inorganic Chemicals.

**ION EXCHANGE** - A process whereby a positively or negatively charged ion exchanges itself with a similarly charged contaminants ion in the drinking water. Treats hardness, inorganic chemicals, and radionuclides.

**LCRMRs** - Lead and Copper Rule Minor Revisions.

**LEGIONNAIRE'S DISEASE** - A type of pneumonia that results when aerosols containing some types of bacteria *Legionella* are inhaled by susceptible persons, not when people drink water containing *Legionella*. (Aerosols may come from showers, hot water taps, whirlpools, and heat rejection equipment such as cooling towers and air conditioners).

**MARGINAL CHLORINATION** - Application of chlorine to produce the desired total chlorine residual without reference to the amounts of free or combined chlorine present.

**MCL - MAXIMUM CONTAMINANT LEVEL** - The maximum permissible level of a contaminant in water that is delivered to any user of a public water system. MCLs are legally enforceable standards. For deployment setting defer to the DoD Tri-service Drinking Water Standards.

**MCLG - MAXIMUM CONTAMINANT LEVEL GOAL** - The maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety. MCLGs are not legally enforceable but are health goals.

**MCO** - Marine Corps Order.

**MEDICAL BACTERIOLOGICAL SAMPLING/SURVEILLANCE** - Bacteriological testing by the preventive medicine authority when warranted. It is not intended to meet SDWA compliance monitoring requirements.

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**MEG - MILITARY EXPOSURE GUIDELINE** - Water quality chemical exposure guidelines for Deployed Military Personnel per USACHPPM TG230.

**Mg/L** - milligram per liter (part per million/PPM).

**NAVFAC** – Naval Facilities Engineering Command.

**NON-COMMUNITY WATER SYSTEM** - A public water system that is not a community water system. These can be either transient non-community water systems or NTNCWS.

**NON-POTABLE WATER** - Water that has not been examined, properly treated, or approved by proper authorities as being safe for domestic consumption. All waters are considered non-potable until declared potable by the regulatory authority.

**NPDWR - NATIONAL PRIMARY DRINKING WATER REGULATIONS** - Legally enforceable standards that apply to public water systems. These standards protect drinking water quality by limiting the levels of specific contaminants that can adversely affect public health and are known or anticipated to occur in public water supplies.

**NSDWR - NATIONAL SECONDARY DRINKING WATER REGULATIONS** - Nonenforceable Federal guidelines regarding cosmetic effects (such as tooth or skin discoloration) or aesthetic effects (such as taste, odor, or color) of drinking water.

**NSF** - National Sanitation Foundation International.

**NTNCWS - NON-TRANSIENT NON-COMMUNITY WATER SYSTEM** - A public water system that is not a community water system and that regularly serves at least 25 of the same persons over 6 months per year. Some examples are schools, factories, office buildings, and hospitals which have their own water systems.

**NTU** - Nephelometric Turbidity Unit.

**OCONUS** - Outside CONUS (overseas).

**OEBGD** - Overseas Environmental Baseline Guidance Document.

**ORGANIC CHEMICALS** - Carbon-based chemicals, such as solvents and pesticides, which can get into water through runoff from croplands or discharge from factories.

**ORM** - Operational Risk Management.

**OSHA** - Occupational Safety and Health Administration.

**PAC** - Powdered Activated Carbon.

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**PALATABLE WATER** - Water that is pleasing to the taste and is significantly free from color, turbidity, and odor. Palatability does not imply potability and vice versa.

**PATHOGENS** - Disease-causing organisms, such as some bacteria, viruses, or protozoa.

**PERCHLORATE** - A contaminant that exists in the environment as a part of other chemical compounds such as ammonium, potassium, or sodium perchlorate. The concerns surrounding perchlorate contamination involve its ability to affect the thyroid gland, which can affect metabolism, growth, and development.

**PMA - PREVENTIVE MEDICINE AUTHORITY** - The medical department representative(s) responsible for public health (preventive medicine). This will be the senior environmental health officer/preventive medicine technician for the area of responsibility. In their absence, Army Veterinary technicians, independent duty corpsmen, senior general duty corpsmen or medical officers may be designated.

**POE - POINT OF ENTRY TREATMENT** - Treatment device or technology intended to treat all water entering a residence or building.

**POTABLE WATER** - Water that has been treated and confirmed via testing to meet established water quality standards and declared fit for domestic consumption.

**POU - POINT OF USE TREATMENT** - Treatment device or technology intended to treat water at a single tap.

**PRIMACY** - Primary enforcement authority for the drinking water program. Under the Safe Drinking Water Act, States, U.S. territories, and Indian tribes that meet certain requirements (including setting regulations that are at least stringent as EPA's) may apply for, and receive, primary enforcement authority.

**PWS - PUBLIC WATER SYSTEM** - A system for the provision to the public of piped water for human consumption, if such system has at least fifteen service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year. Such term includes (1) any collection, treatment, storage, and distribution facilities under control of the operator of such system and used primarily in connection with such system; and (2) any collection or pretreatment storage facilities not under such control which are used primarily in connection with such system. A public water system is either a "community water system" or a "non-community water system."

**RADIONUCLIDE** - An unstable form of a chemical element that radioactively decays, resulting in the emission of nuclear radiation. Prolonged exposure to radionuclides increases risk of cancer.

**RAW WATER** - (1) Untreated water, usually the water entering the first treatment unit of a water treatment plant. (2) Water used as a source of water supply taken from an impounded body of water, such as a stream, lake, pond, or a well.

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**REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTER** - An assembly of differential valves and check valves including an automatically opened spillage port to the atmosphere designed to prevent backflow.

**RO - REVERSE OSMOSIS** - A pressure-driven treatment process using a specially prepared membrane that permits the flow of water through the membrane, but acts as a selective barrier to contaminants.

**ROWPU** - Reverse Osmosis Water Purification Unit.

**SANITARY DEFECTS** - Conditions that may cause the contamination of water supply during or after treatment. These include connections to unsafe water supplies, raw water bypasses in treatment plants, plumbing fixtures improperly designed and installed, and leaking water and sewer pipes in the same trench.

**SANITARY SURVEY** - An engineering onsite review of the water source, facilities, equipment, operation and maintenance of a public water system for the purpose of evaluating the adequacy of such source, facilities, equipment, operation and maintenance for producing and distributing safe drinking water.

**SDWA** - Safe Drinking Water Act.

**SMCL** - Secondary Maximum Contaminant Level.

**SOCs** - Synthetic Organic Contaminants.

**SPRING** - A spring is a concentrated discharge of ground water appearing at the ground surface.

**SUPPLIER OF WATER** - Any person who owns or operates a public water system.

**SWTR** - Surface Water Treatment Rule.

**TCR** - Total Coliform Rule.

**THM** - Trihalomethane.

**TOTAL AVAILABLE CHLORINE** - The sum of the chlorine forms present as free available chlorine and combined available chlorine. Total Chlorine residual is used for halogen surveillance of potable water systems which use chloramine in lieu of chlorine for disinfection.

**TRANSIENT, NON-COMMUNITY WATER SYSTEM** - A public water system which provides water in a place, such as a gas station or campground, where people do not remain for long periods of time. These systems do not have to test or treat their water for contaminants that pose long-term health risks, because fewer than 25 of the same people drink the water over a long period. They still must test their water for microbes and several chemicals posing short term health risk.

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**TREATED WATER** - Water that has undergone processing (such as sedimentation, filtration, softening, disinfection, etc) and is ready for consumption. Included is purchased potable water that is retreated (chlorinated, fluoridated, etc).

**TT - TREATMENT TECHNIQUE** - A required process intended to reduce the level of a contaminant in drinking water.

**TTHM - TOTAL TRIHALOMETHANES** - The sum of the concentration in milligrams per liter of the trihalomethane compounds (trichloromethane [choloroform], dibromochloromethane, bromodichloromethane, and tribromomethane [bromoform]) rounded to two significant figures.

**TURBIDITY** - The cloudy appearance of water caused by the presence of tiny particles. High levels of turbidity may interfere with proper water treatment and monitoring.

**UFC** - Unified Facilities Criteria.

**ug/L** - microgram per liter (part per billion).

**UV** - Ultraviolet.

**VACUUM BREAKER, NONPRESSURE TYPE** - A device or means to prevent backflow designed not to be subjected to static line pressure.

**VACUUM BREAKER, PRESSURE TYPE** - A device or means to prevent backflow designed to operate under conditions of static line pressure.

**VIOLATION** - A failure to meet any State, Federal, or DoD drinking water regulation.

**VOCs** - Volatile Organic Compounds.

**VULNERABILITY ASSESSMENT** - A systematic evaluation of a potable water system by Public Works, Anti-Terrorism Officer and other installation parties, to determine if the potable water system is vulnerable to natural and/or man-made disasters, or terrorists activities. This includes a list of recommendations to eliminate or decrease any vulnerability to the system from these threats.

**WATER QUALITY** - The chemical, physical, radiological, and microbiological characteristics of water with respect to its suitability for a particular purpose.

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### Appendix C

<b>PREVENTIVE MEDICINE ASSISTANCE</b>
Officer in Charge Navy Environmental and Preventive Medicine Unit 2 1877 Powhatan Street Norfolk, VA 23511-3394 Commercial: (757) 444-7671 DSN: 564-7671
Officer in Charge Navy Environmental and Preventive Medicine Unit 5 3235 Albacore Alley San Diego, CA 92136-5199 Commercial: (619) 556-7070 DSN: 526-7070
Officer in Charge Navy Environmental and Preventive Medicine Unit 6 1215 North Road Pearl Harbor, HI, 96860-4477 Commercial: (808) 471-9505
Commanding Officer Navy and Marine Corps Public Health Center 620 John Paul Jones Circle Portsmouth, VA 23708-2103 Commercial: (757) 953-0700 DSN: 377-0700

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### **Appendix D**

#### **DRINKING WATER QUALITY STANDARDS NATIONAL PRIMARY DRINKING WATER REGULATIONS (NPDWR)**

Drinking water quality standards referred to as Maximum Contaminant Levels (MCLs) are frequently amended or revised. For DoD installations in the United States and its territories, refer to the EPA Web page <http://www.epa.gov/safewater/mcl.html> for the latest MCLs for the Primary and Secondary Drinking Water Standards. For OCONUS installations refer to the *Final Governing Standards* or *Overseas Environmental Baseline Guidance Document* for the applicable drinking water quality standards.

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### Appendix E

#### BACTERIOLOGICAL SURVEILLANCE OF DRINKING WATER

1. Current EPA regulations known as the Total Coliform Rule set forth the microbiological water quality standard for public water systems. Each public water system must have a written sampling plan that lists the frequency and locations of samples to be collected including repeat samples when indicated.
  - a. The significance of the various coliform organisms in water is the subject of considerable debate. All types of coliform organisms may occur in feces but may occur in other places as well. *E. coli* is a subset of total coliform organisms. *E. coli* organisms are associated with animal and human waste contamination.. Presence of other coliform organisms such as *Enterobacter* and *Klebsiella* bacteria species often indicates contamination from environmental sources. Growth of bacteria, particularly coliforms in water distribution systems leads to biofilm development. Biofilms are significant since they are capable of harboring pathogenic organisms and impede disinfection of water. Heterotrophic bacteria are primarily responsible for biofilm growth. HPC testing is often completed to define potential impact of biofilm growth and potential impact on the water disinfection process. Many water systems reporting coliform occurrences in their distribution systems have determined the predominant organism was a member of the *Klebsiella* genus. *Klebsiella* can normally be controlled through adequate disinfection. However, if passage into the distribution system occurs the bacteria may harbor in particulate matter and porous pipe sediments. Presence of total coliform bacteria is a drinking water quality violation requiring prompt remedial action. Presence of *E. coli* is an acute health violation and requires immediate action. When any drinking water quality MCL are violated the water purveyor is required to submit Public Notification Reports as required by law and Naval directives.
  - b. EPA sets forth specific guidance in the TCR regarding response to Tier I or Tier II in response to MCL microbiological violations.
2. Any EPA-approved microbiological test may be utilized by certified lab or the Preventive Medicine Authority. The current edition of Standard Methods For the Examination of Water and Wastewater and the EPA-approved laboratory tests should consulted for proper testing procedures. All water samples should be collected per accepted laboratory technique.

<b>Collecting a Water Sample</b>
Remove screens, aerators, vacuum breakers, or any other device and allow the cold water tap to flow freely for 2-3 minutes.
Using aseptic technique collect 100-120 ml of water in approved bottle/bag containing sodium thiosulfate. Leave an air space top of bottle/bag to allow mixing of reagent in laboratory.
Label sample with location, date, time, and halogen residual.
Refrigerate samples if not tested within 1 hour of collection.

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### Appendix F

<b>Reverse Osmosis Water Purification Unit (ROWPU)</b>		
<b>DoD Field Water Chlorine Residual Requirements</b>		
<i>Note: Applies only to field water systems not PWS on CONUS or OCONUS locations</i>		
<b>Location</b>	<b>Chlorine (FAC) residual</b>	<b>Comment</b>
ROWPU Production Site	2.0 ppm/30-minute contact time	Water that is treated by any method other than a ROWPU operator add sufficient chlorine to provide a 5.0 ppm FAC with a minimum 30-minute contact time.
Tactical Water Distribution Systems (TWDS) Issue Points	2.0 ppm	Storage Systems (800K, 300K, and 40K systems) Fabric tanks for bulk transport; Water purification personnel are to adjust the chlorine level at potable water issue points along the TWDS. Maintaining 1.0 ppm FAC in the distribution system may require adjusting chlorine levels at the production site higher than 2.0 ppm FAC after a 30-minute contact time. If chlorine residuals at the completion of bulk transport have trace or < 1.0 ppm FAC, the water must be rechlorinated to 2.0 ppm FAC. After being chlorinated the water may be immediately used. If a trace level of chlorine can not be measured the water must be rechlorinated to 2.0 ppm FAC with a 30-minute contact time prior to consumption.
Unit level distribution (tap/point of consumption)	1.0 ppm*	400 gallon water trailers, camels, lightweight collapsible pillow tanks, etc.

\* Medical Authority may require higher levels of FAC levels based on potential for endemic waterborne diseases and other medical threats..

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### Appendix G

#### ***LEGIONELLA***

*Legionella pneumophila* is a bacterium often found in stagnant waters and has been associated with cooling towers for air conditioning and heating systems for buildings. This bacterium is known to cause Legionnaires Disease, a type of pneumonia. Other *Legionella* bacteria can cause symptoms similar to pneumonia and are of particular concern to persons with underlying illness, such as is typically found in hospitalized patients. *Legionella* is commonly found in warm waters (120 degrees F) and the suspected route of human exposure is via inhalation. Aerosols from shower heads and faucets are likely sources for spreading the bacteria to humans. In a health care setting due to increased patient risks and concerns regarding nosocomial infections more aggressive intervention and remedial action is warranted.

The Maximum Contaminant Level Goal (MCLG) for *Legionella* in drinking water is zero. For microbial contaminants identified in the Surface Water Treatment Rule (SWTR) EPA did not develop a MCL but instead established Treatment Techniques (TT) requirements. Filtration is very effective at removing *Legionella* bacteria from surface water sources, however, small numbers of the bacteria can pass through and regrowth (biofilm) may occur at various points downstream of the water plant. Cooling towers systems have been incriminated with *Legionella* growth and linked to disease outbreaks. In investigating legionella outbreaks refer to the Occupational Safety and Health Administration (OSHA) Technical Manual on Legionnaires' Disease.

Surface Water Treatment Rule/Treatment Technique (SWTR TT) requires water systems to achieve a 99.9 percent (3 log) reduction of *Giardia* cysts and a minimum of 99.99 percent (4-log) reduction of viruses. Removal and inactivation of these contaminants will provide adequate removal/ inactivation of *Legionella* and HPC bacteria. The two TT commonly used to achieve compliance are: filtration and disinfection (chlorination).

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### **Appendix H**

#### **HETEROTROPHIC PLATE COUNT (HPC)**

Characterizing the occurrences of these diverse organisms can best be done with a sensitive measurement of the heterotrophic bacterial population and formulating a realistic density limit. These microorganisms represent a class of non-Coliform bacteria commonly found in drinking water. Though not yet regulated, their presence in any given sample location at densities greater than 500 colonies per milliliter indicates poor microbial control, the presence of conditions that are favorable towards bacterial regrowth (biofilm formation) and the potential to interfere with the coliform test. Some types of Heterotrophic Plate Count (HPC) bacteria are considered to be opportunistic pathogens that pose a health risk to the very young, the elderly and those with suppressed or compromised immune systems. A description of the sampling and analytical methods associated with the HPC test can be found in the latest edition of Standard Methods of Water and Wastewater Analyses. Contact the area Navy Environmental Preventive Medicine Unit for further guidance and assistance regarding HPC testing or a State certified water quality laboratory.

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### **Appendix I**

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OPNAVINST 5090.1 series, Environmental and Natural Resources Protection Manual.

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BUMEDINST 6240.10 series, Standards for Potable Water.

NAVMED P-5010-1, Food Safety.

NAVMED P-5010-6, Water Supply Afloat.

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29 CFR Part 1910, OSHA Safety and Health Standards.

40 CFR Part 141, National Primary Drinking Water Regulations.

40 CFR Part 142, National Primary Drinking Water Regulations.

40 CFR Part 143, National Secondary Drinking Water Regulations.

21 CFR Parts 103, 110, 29, and 65, Bottled Water Regulations.

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Developing a State Wellhead Protection Program: A User's Guide to Assist State Agencies Under the Safe Drinking Water Act.

Lead and Copper Rule Guidance Manual Volume I, Monitoring.

Lead and Copper Rule Guidance Manual Volume II, Corrosion Control Treatment.

Lead and Copper Monitoring and Reporting Guidance for Public Water Systems, EPA-816-R-02-009 (February 2002).

Cross Connection Control Manual, EPA No. 570-89-007.

Water on Tap: A Consumer's Guide to the Nation's Drinking Water, EPA No. 815-K-97-002.

Control of Biofilm Growth in Drinking Water Distribution Systems, EPA 625/R-92/001.

Sampling for Lead in Drinking Water in Nursery Schools and Day Care Facilities, EPA 812B94003 (1994).

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USACHPPM Technical Guide No. 179, Guidance for Providing Safe Drinking Water at Army Installations.

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